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COVER

Our artist, Howard V. Brown, has depicted this month the unique motorcycle designed and built by an English aviator, and illustrated on page 16. The painting serves as a fitting introduction to this issue which contains a high percentage of motor vehicle material.

The Electric Word

The Rise of Radio

By PAUL SCHUBERT

A RADICALLY different treatment of the subject than anything that has yet appeared, giving the inside of the political and business intrigues through which the art has emerged to be controlled by large interests such as R. C. A., etc. The fascinating story of the solution of the German war code; the rescue of the complicated patent situation by the Navy; the results of recent patent suits which have been of such importance to the industry, and many other phases which have never before been so adequately presented. The scientific aspect is naturally thoroughly covered. Postpaid $2.65.

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By MILTON WRIGHT

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Amateur Telescope Making

ALBERT G. INGALLS, Editor

SO successful was the first edition of this book that with the aid of some of the foremost astronomers of the world, a new work has been produced. This new and enlarged edition contains all that was in the first with 200 pages of added advanced material, making a complete and authoritative treatise of all that can be collected. From a simple telescope to the spectroheliograph, etc., the treatment is always outlined for the layman. Postpaid $3.50.

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Looking Ahead *With the* Editor

The Wise Ibex

TO many people, a hunt for big game animals is the very soul and essence of enjoyment. The more wary the game, the greater the thrill. Thus a curator of mammals in a great museum says that his supreme thrill came when long-horned ibex of the Red Sea highlands fell before his rifle on his first African hunt. His story is so vivid and human that, when you read it in a future issue, you'll live the hunt with him.

The Romans in England

HISTORY dwells briefly on the occupation of Brittania by the Romans but it is not generally known that this virile, conquering race established an almost permanent residence on English soil. Archeologists have uncovered, in England, stone pavements, remains of handsome buildings, pottery, trinkets, and coins. Soon we will publish an article dealing with old Anglo-Roman days as evidenced by the scientists' finds.

Netherlands of the New World

DOWN in North Carolina, drainage and reclamation engineers are doing big things. For the New Holland project, organized by August Heckscher, they've reclaimed 100,000 acres of land near Lake Mattamuskeet which is three feet below sea level. Thriving farm crops now grow where bull-rushes recently grew and more of the land is being cultivated all the time. The story of this development is coming.

This World in Which We Live

"WHO has not asked himself, 'What is this world around me?' Rocks, trees, human beings—what are the parts of which these are made and how are these parts put together?" Are you not intrigued by this and "the dance of the molecules, the fingerprint of an atom, the paradox of light, playing billiards with protons and electrons?" Then look for the article with this prologue, coming in these pages soon.

Chemical Alarm Clocks

THIS odd name is appropriately given by the author of a story on hand, to the chemicals that have the properties of forcing early blooming of florists' favorites, causing early germination of new potatoes which, otherwise, would be no good as seed, imparting a golden glow to citrus fruits, and literally "waking up" other plants from long rest periods. While essentially not a new discovery, great possibilities are seen for the commercial development of this plant-awakening process.

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¶ *The well-informed man or woman is the one who progresses. Why not let the* SCIENTIFIC AMERICAN *bring to you the latest news of the scientific world in general? The cost is nominal—only four dollars for an entire year's subscription.*

Among Our Contributors

J. C. McLennan

By reason of his extensive researches, Professor McLennan is well qualified to discuss with authority the age-old secrets of the aurora borealis, or "northern lights." He has investigated and written treatises on the subjects of electrical conductivity of gases, radioactivity, magnetism, penetrating radiations at the surface of the earth and their properties, spectroscopy and low-temperature characteristics of liquid hydrogen and liquid helium, and others. A Canadian by birth, Professor McLennan was educated in Canada and England, and is now a professor of physics in the University of Toronto, Canada. In 1919 he was scientific advisor to the British Admiralty.

N. H. Goss

The concluding article of the discussion of naval strength by Captain N. H. Goss, U.S.N., is published on page 38. For factual and empirical content, this series has been acclaimed the best, most dispassionate work of its kind ever to be presented to the American people. Even critics of the navy give Captain Goss, who is now in active command of the *U. S. S. Sirius*, credit for clarifying a complex, disquieting question.

R. C. Binkley

Dr. Binkley, who contributes in this issue a timely discussion of the rapid deterioration of ground-wood pulp paper, first came in contact with the paper problem while collecting documents in Europe for the Hoover War Library. He was reference librarian for that library for five years and is now teaching history at New York University. He is the author of a book about the new governments of Central Europe.

Chester A. Reeds

Dr. Reeds, Curator of Geology and Invertebrate Paleontology in the American Museum of Natural History in New York City, is widely known in the scientific world for his work in these two subjects. He has been lecturer and instructor in several American colleges and universities, field assistant of the United States Geological Survey for several summers, and leader of two field parties for the American Museum—one in Oklahoma, and the other in Porto Rico.

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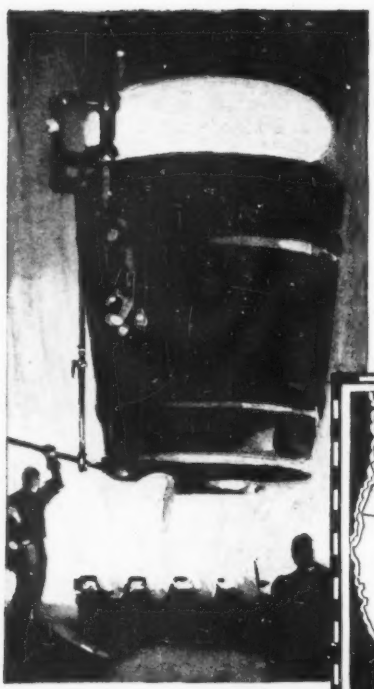
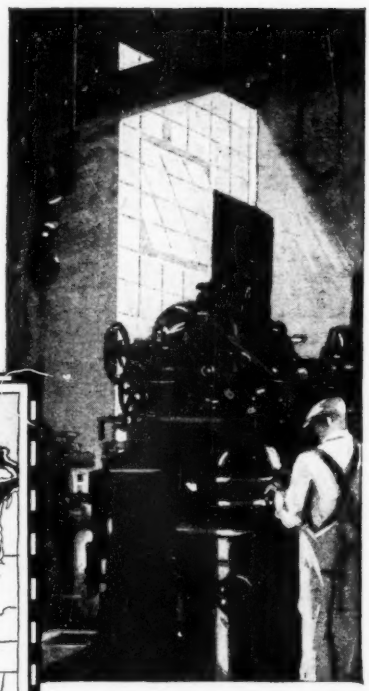




Los Angeles

THE INDUSTRIAL COUNTY

Foundries and Machine Shops flourish in great concentrations of population because their product is a basic need of modern life. The value of the production of this industry in Los Angeles County places it first among all counties west of Chicago. The production of all factories in Los Angeles County in 1927 reached over *one billion dollars*—(Government figures).

Los Angeles County is the largest market and industrial center in the West. It's local market comprises more than 4,000,000 people, over one-third of the purchasing power of the eleven Western States.

It contains nearly twice the number of factories and well over double the wage earners —wages paid—and value of output—of the next most important industrial County west of St. Louis.

But what is more important, its rate of industrial growth is overwhelmingly faster than any County of comparative importance in the whole country.

It is not a one-industry community—its manufacturing is highly diversified.

While Los Angeles County is known as the world's movie capital, its largest city outranks in manufacturing all cities west of Chicago in automobile parts and accessories, rubber tires, oil refining, wearing apparel, structural and ornamental iron and various other industries. One of these is foundry and machine shop products, with an output of over $30,000,000 per year.

Locate your Pacific Coast plant in Los Angeles County, the center of Western industrial expansion. For specific information kindly address—Industrial Department, Los Angeles Chamber of Commerce.

INDUSTRIAL LOS ANGELES COUNTY

Prof. J. J. Thomson

STUDENTS of physics will recognize at once the name of this brilliant English physicist, who, since 1918, has been Master of the famous Trinity College at Cambridge, England. Professor Thomson's early work in the realm of physics, especially in connection with electricity and magnetism, is too well known to be dealt with at length here, but his more recent work on the structure of matter is worthy of mention. At the first of a series of Founders' Memorial Lectures, delivered at Girton College in the early part of 1928, he gave a lecture entitled "Beyond the Electron," which has recently been issued in book form under the same title, and has received a hearty welcome. In this work, Professor Thomson points out that he does not consider the electron as being the ultimate form of matter, but as only another stepping stone in the vast subject of atomic physics. His views are of special interest to those who have followed the lucid articles on the de Broglie and Schrödinger atomic concept presented in recent issues of this magazine.

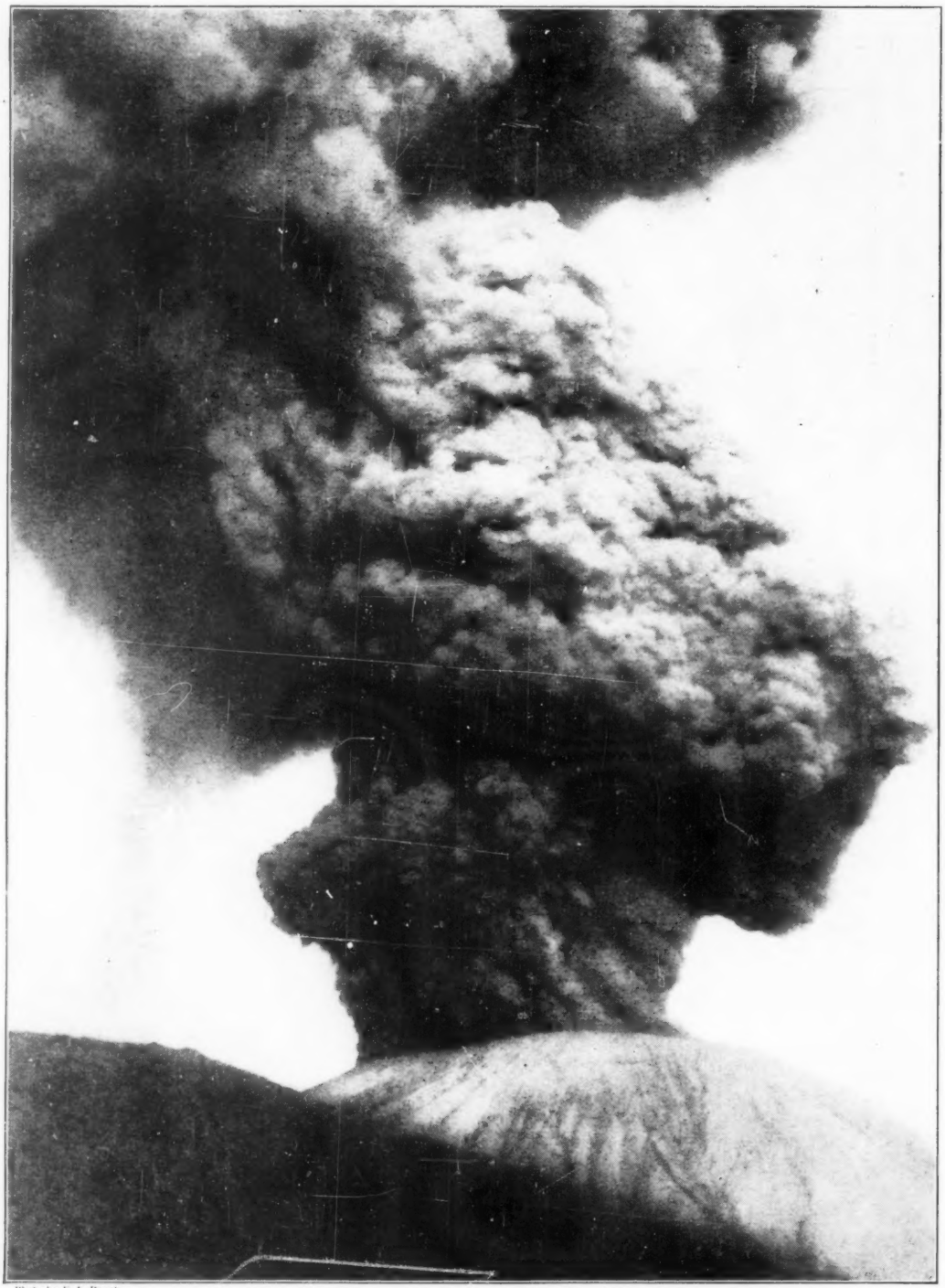


Photo by F. A. Perret

The Crater Cloud of Vesuvius

DURING the latter part of the eruption of April 14, 1906, great masses of material would fall from the sides of the crater and partially block the vent. This would often cause a great cloud of gas and ash—half a mile in diameter—to rise in majestic, spiral curves, and this condition would persist for hours until the vent could again clear for itself a vertical passage.

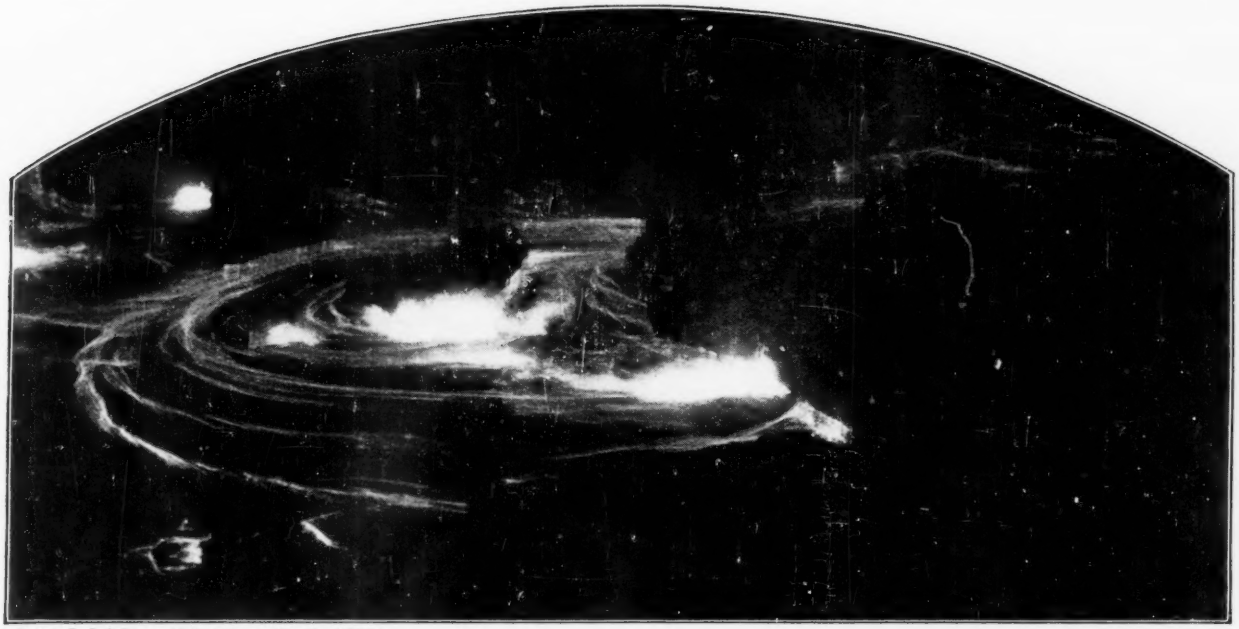


Photo by Dr. E. O. Hovey. All illustrations courtesy *Natural History*

A LAVA LAKE AT NIGHT

The Halemaumau pit in the crater of Kilauea, Hawaii, was filled for many years with a "lake of fire." The hardened lava in the center lasted for several months, forming a veritable island. This appeared as the top of a low truncated cone in the center of the lake

Belching Cauldrons of the Earth

Awe Inspiring to an Infinite Degree Are the Titanic Eruptions of Great Volcanoes

By CHESTER A. REEDS, Ph.D.

Curator of Geology and Invertebrate Paleontology, American Museum of Natural History

THE eruption of a volcano is perhaps the most impressive and awe-inspiring phenomenon known. The stupendous releasing of matter and energy, the unhurried modulation of its periodic beats, the seismic pulsing of the ground and the exceedingly rapid undulations of electric flashes in the cloud of ash, produce not only a sublime manifestation of rhythm, but of infinite dignity. Perret, in 1924, wrote: "No words can describe the majesty of its unfolding, the utter absence of anything resembling effort, and the all-sufficient power to perform the allotted task and do it majestically." The immensity of these forces, the magnitude of the results achieved, and the disastrous consequences which an eruption frequently entails, impress the human mind with the vast amount of dynamic energy pent up within the earth.

The 65 active volcanoes scattered over the surface of the earth are not in maximum eruption every day. Judging from their known histories, it is apparent that each volcano acts more or less independently of the others, and that the activity of most of them is intermittent with paroxysms of greater or lesser violence occurring after intervals of comparative, or even complete, repose. Stromboli, one of the Lipari Island volcanoes, has been characterized by a moderate, although somewhat constant, activity during 2000 years. To mariners it is known as the "lighthouse" of the Mediterranean. If the period of quiescence has been long, the renewed activity of a volcano is apt to be exceptionally violent. For example, Krakatoa, near Java, had been dormant for about two centuries before the great eruption of 1883.

ONE of the greatest of volcanic eruptions in recent years was that of Sakurajima in southern Japan. This volcano, with a cone shaped very much like Vesuvius, rises to a height of 3506 feet. Previous eruptions of this volcano had built up a circular island about seven miles in diameter in Kagoshima Bay, and upon it there were eighteen villages with an aggregate population of 22,000 farmers and fisher folk. Two miles of water lay between the western margin of the volcanic island and the shore of the larger Kyushu Island, on which stood the city of Kagoshima with a total population of seventy thousand persons.

The observatory of Kagoshima had recorded 91 earthquakes in 1913 as compared with only 34 for each of the years preceding. Early in January, 1914, this station noted an ever increasing number of earthquakes, and between 4 A.M. of January 11, and 10 A.M. of January 12, 417 quakes were recorded, many of them strong. The situation was ominous, and due to a knowledge of the significance of earthquakes in the vicinity of volcanoes, developed in Japan since 1890, the people in this region were forewarned, and those who dwelt on Sakurajima Island were removed prior to the violent eruption, which began at 10:05 A.M. of January 12, 1914.

The first outburst of gas, steam, and ash, which was from the western vent opposite the city of Kagoshima, reached elevations of between five and six miles in height. Ten minutes later a similar column rose from three crater pits on the eastern side of the mountain. Glowing bombs, hot sand, flashes of lightning, great billows of smoke, and seismic shocks waxed in fury. A terrific earthquake at 6:29 P.M. threw down walls and buildings in

THE SINKING OF THE ISLAND ➤

The tip of the island in Halemaumau pit, just before it sank. This is a telephoto view—Frank A. Perret, the volcanologist, leaned far out over the edge to get a pictorial record of this strange occurrence

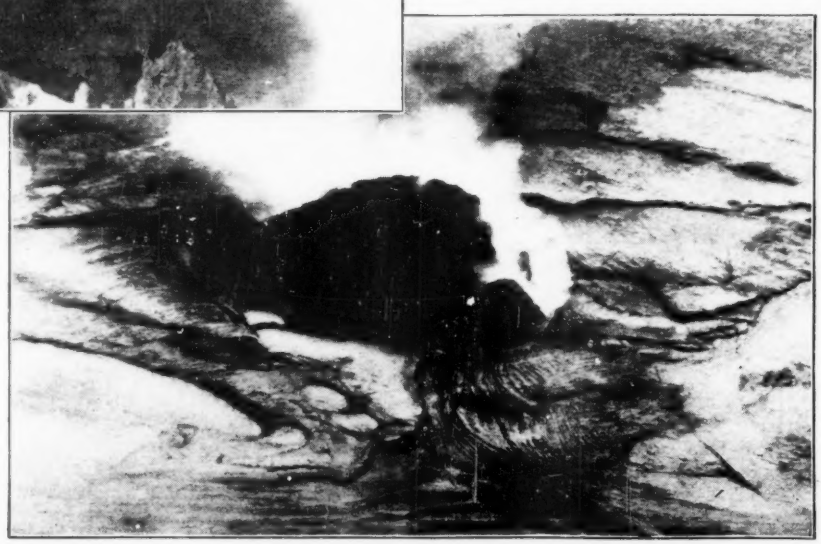
Kagoshima, causing the death of 35 persons and the injury of 112, the only casualties during this great eruption. This great shock was accompanied by outflows of lava on both the eastern and western sides of the volcano. Following these great outbursts, intense activity continued in the western craters until January 20, while in the eastern ones it persisted for several months.

The volcanoes which emit lava in greatest volume are comparatively quiet in their action. This is the case with the volcanoes of Iceland and Hawaii, which erupt dark basaltic lavas. Eruptive cycles have been recognized in this type of volcano in Mauna Loa, 13,900 feet high, and Kilauea, 4000 feet above the sea, both on the island of Hawaii. Kilauea, being at a lower elevation, is more readily reached than Mauna Loa, and since Professor T. A. Jaggar established a volcano observatory there in 1911, its action has been studied more closely than that of any other volcano in the Pacific Ocean.

KILAUEA was discovered in 1823, and except for widely separated intervals of short duration, a "lake" of molten lava is reported to have occupied the central portion of the crater until 1894. When first observed in 1823, there was a great pit 1700 feet deep, known as Halemaumau, but subsequently the molten lava rose and frequently welled over the confining walls to stream away over the adjacent crater floor. These repeated upwellings gave rise to a low, flat cone in the region of the central "lake."

The molten lava, which disappeared into the depths of the pit in May, 1913, re-appeared in October, 1913, forming spatter cones, boiling pots, and areas of overflow, at the bottom of the pit. Then it gradually raised its surface in a fluctuating way until October, 1914, when a molten "lake" again appeared. This condition, with fluctuations in height and vigor of surface action, prevailed until May, 1924, when Kilauea exploded.

Photo by F. A. Perret



➤ BALL-HEADED VORTEX EXPLOSION

This is the crater of Stromboli. After a stor[illegible]e of perhaps fifteen minutes the gase[illegible]st through the plug to form a rotat[illegible]ortex, the gas carrying up stones

The amount of rock removed by the May, 1925, explosion, as noted by Professor Jaggar, was 28 million cubic feet, while that removed by engulfment was 253 times as great. The crater pit was enlarged fourfold not by the attrition and ejection due to gas rushes, but by collapse of the walls into a void below, just as it was enlarged by collapse in 1913, 1918, 1919, 1920, 1921, greatly in 1922, and again in 1923, all without explosions. The May, 1924, explosive eruption was thus merely an incident in a mechanism of engulfment. This event increased the depth of the pit from 400 feet to 1000 feet, and it has been calculated that the shaft, which would hold the rock that was engulfed, must be 8000 feet in diameter and more than 3000 feet deep.

The eruptions of the volcanoes Soufriére and Mont Pelée in the islands of St. Vincent and Martinique,

STROMBOLI IN ACTION ➤

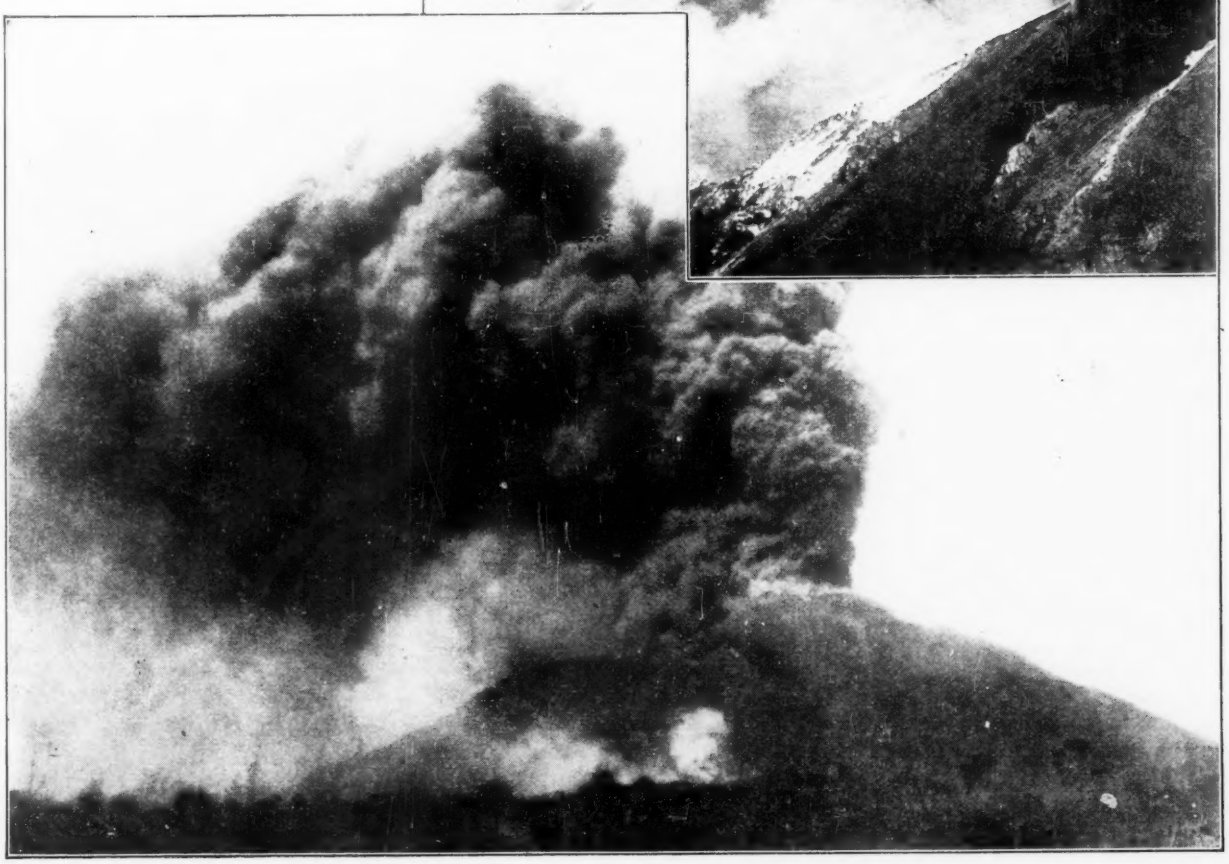
A beautiful picture of ash and steam emission at the crater of Stromboli. From a small vent much ash is carried up and can be seen falling in showers

Photo by F. A. Perret

VESUVIUS IN ERUPTION ▼

An early phase of the great eruption of 1906. The main lava stream broke out on the mountain side. The emission of gas and ash was continuous but pulsating

Photo by F. A. Perret



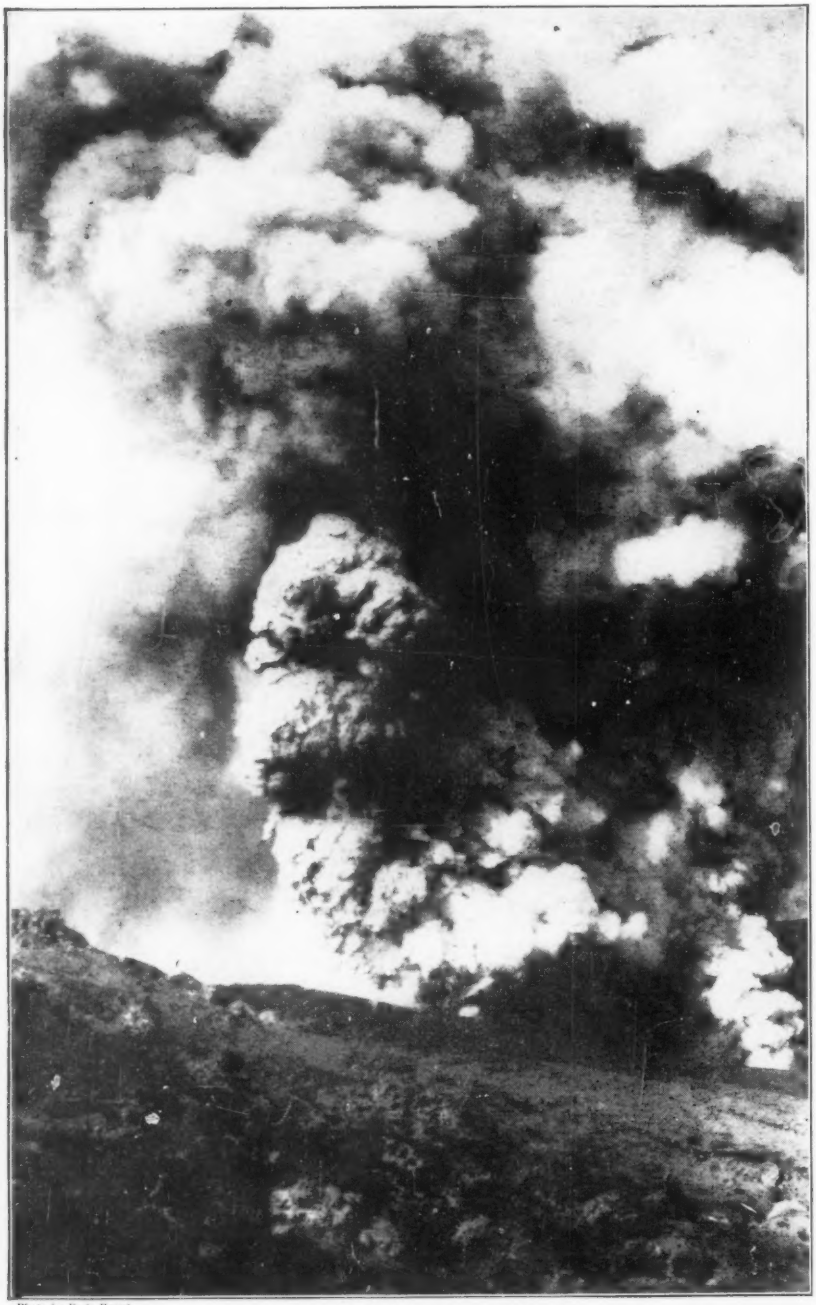


Photo by F. A. Perret

"CAULIFLOWER" ASH CLOUDS

In Japan the 1914 eruption of Sakurajima continued in action for many months, send ing vast quantities of lava into the sea, and emitting huge ash clouds in continuous succession

respectively, on May 7 and 8, 1902, furnished a type of activity not previously recognized by volcanologists. These eruptions were characterized by the sudden emission of dense black clouds of superheated and suffocating gases heavily charged with incandescent dust, lapilli, and "bread-crust" bombs, which rose to heights of 12,000 feet and moved swiftly down the slopes of the volcanic cones like a hot avalanche, called *nuée ardente* by Lacroix.

According to Perret, the conditions requisite for the formation of a *nuée ardente* are believed to be a pasty lava, very highly charged with gas and so near the mouth of the crater that it might be expelled in the forms manifested at Mont Pelée and the Soufrière. Heilprin, Fenner, and Perret have noted that it is not improbable that a Peléean *nuée ardente* happened during the Plinian eruption of Vesuvius in 79 A.D., during the Katmai volcano eruption in Alaska in 1912, and during the 1914 eruption of Sakurajima in Japan.

The deadly effect of the Peléean blasts in Martinique and St. Vincent, which killed, within a few minutes, some 42,000 people, seems to have been due chiefly to the irritation of the mucous membrane of the respiratory passages by the fine hot dust. Those persons near the Soufrière, who took refuge in cellars, and the one prisoner in the dungeon at St. Pierre, escaped with their lives.

Vesuvius, in Italy, is the world's best known and most fully studied volcano. Of the period prior to the Christian era, little is known concerning the activity of this volcanic vent. The Greek geographer, Strabo (B.C. 63-A.D. 24), believed it to be a volcanic crater, though extinct. In his day the present complex cone with its *atrium* and partial *somma*, did not exist; instead there was only the complete outer ring, *somma*.

The terrific outburst of 79 A.D. was on such a grand scale that it constitutes one of the most outstanding events in the history of this volcano. This explosion was so tremendous that the greater portion of the cone, the *somma* ring, was blown to bits.

NO streams of lava issued forth, but such a vast quantity of lapilli and ash was thrown out that the city of Pompeii, to the southeast, was covered in places to a depth of 25 to 30 feet, and Herculaneum, to the southwest, was buried by a flood of mud and ash to a depth of 60 feet. These latter deposits have been covered by lava streams of more recent eruptions. From a study of the rocks in the Monte Somma remnant, Johnston-Lavis, 1891, determined a record of 14 periods of eruption and two long intervals of repose preceding the Christian era.

Between 79 and 1631, eight eruptions of Vesuvius are recorded, but little is known concerning them. Except for a slight outburst of ash in 1500, there was a long period of repose—1139 to 1631. During this interval the crater was forested and overgrown with vines, as it had been for a long time previous to 79 A.D. Following this long period of repose, a great explosive eruption occurred in December, 1631. This outburst began on December 15 with rumblings within the crater, following by an opening of a cleft upon the east side of the mountain, and the emission of steam and ash. On the following day, another fissure opened on the south side, from which steam and ash burst forth to overwhelm four nearby cities. On the 18th, four great streams of lava poured from the crater, three of them reaching the sea. Eight towns were overrun by these lavas and 3000 persons lost their lives. This eruption reduced the height of the cone by 560 feet.

Since 1631 five major eruptions have occurred, namely: 1737, 1794, 1822, 1872 and 1906; also nine minor emissions, to wit: 1834, 1839, 1850, 1855,

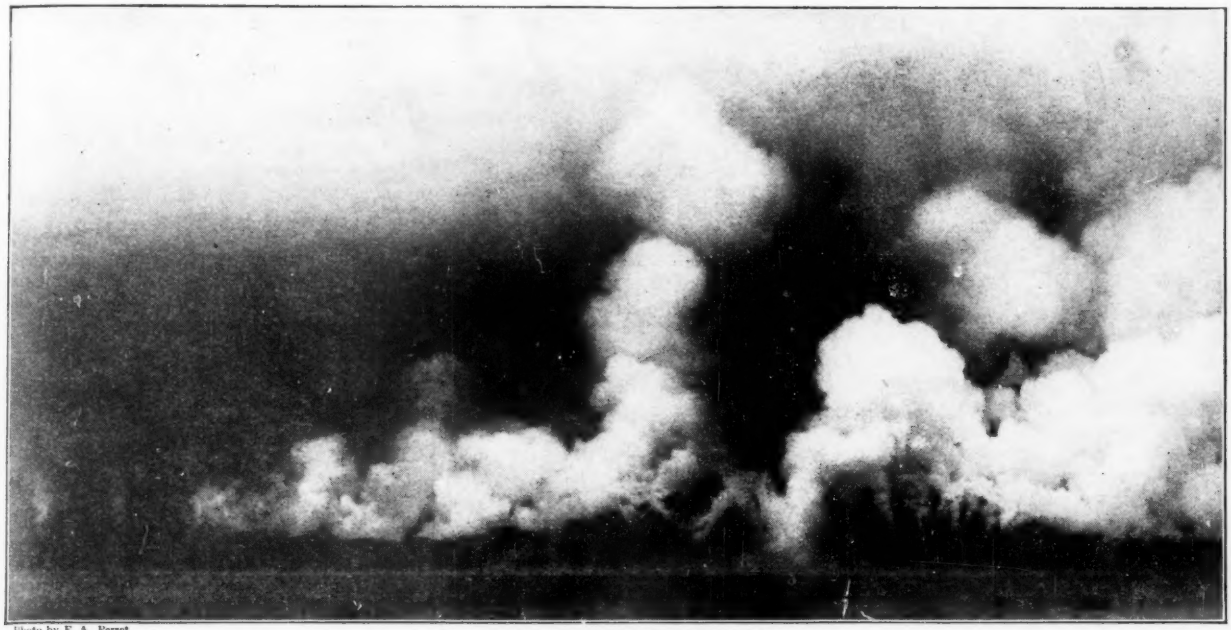


Photo by F. A. Perret

LAVA ENTERING THE SEA

This is the 1914 eruption of Sakurajima. When the material is sufficiently hot, a protective skin is formed on coming in contact with water or snow. In this view the lava is shown entering the water and flowing along the sea bottom without any disturbance at the surface.

1861, 1878, 1899, 1903, and 1913. During this period of almost 300 years a more nearly continuous form of activity has prevailed with explosive and effusive factors more nearly equal in proportion. The conduit of Vesuvius remained open throughout most of the time intervening between these later eruptions, thus causing a diminution and virtual elimination of the severe seismic disturbances which formerly, at the time of an eruption, affected the immediate region so disastrously.

The 1906 eruption of Vesuvius is of special interest not only because it passed through three phases of an eruptive cycle, but since it was carefully studied by the officials of the Vesuvian Observatory, one of whom, Dr. F. A. Perret, an American, has written a full account of those eventful days. Other volcanologists, chiefly French, German, English, and American, have also described this activity; hence it is one of the better known of the Vesuvian eruptions.

According to Perret there has been a marked periodicity in the modern eruptive process of Vesuvius, each great eruption releasing energy and material which have accumulated during a more or less prolonged period of lesser activity, in spite of occasional temporary relief through minor outbreaks. Then follows a period of repose, due to exhaustion and obstruction, after which the renewed supply of magma—rising slowly from the depths—re-establishes a vent at the bottom of the crater-basin, and a new active period ensues, completing a cycle.

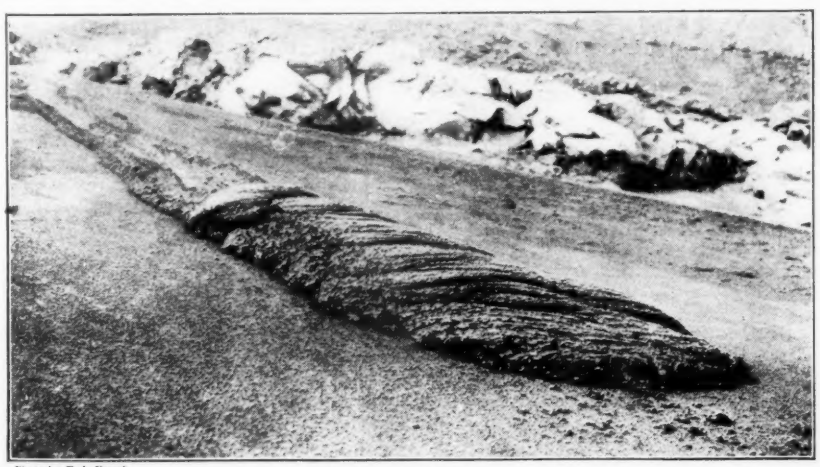


Photo by F. A. Perret

MUD LAVA FLOW

The fine ash combined with rain or condensed vapor makes a liquid mud which starts flowing down the mountain side and often becomes a much feared and destructive flood

Perret, writing in 1922, stated that the great 1906 basin of Vesuvius was then filled to within a short distance of the lowest portion of the rim, giving an accessible crater-bottom similar to that of Kilauea, but with a different kind of activity of far greater degree.

The nature of a volcanic eruption, whether "explosive" or "effusive," is assumed generally to be based upon the mere difference of fusibility of the rock emitted.

AN important factor is whether the conduit has been normally open or closed during the period preceding the eruption. If closed, the magmatic reservoir will generate and accumulate gas in the liquid material within and beneath the volcanic edifice. When gas, the chief eruptive element, has accumulated in the uppermost magma in sufficient quantity to pierce the crater plug, the prompt release and ejection of all or a part of this matter will constitute eruption.

Perret considers the magma a paste, which permits the transfusion of gas and which changes into liquid lava in the upper part of the column. It rises slowly, and when it reaches the zone of fractured rocks, considered to be some six miles thick, it will be exposed to water and air. The assimilation of these modifying elements has a profound effect upon the physical and chemical activities and upon the prolonged existence and repeated functioning of the volcanic vent.

¶ *The foregoing description of volcanic eruptions is of particular interest at this time, due to the activity, as we go to press, of Mt. Etna in Sicily.*

Our Point

Unfinished Business

THE English press continues to be agitated by what it is pleased to call the desire of the United States to limit naval armament further—with reservations favorable to herself. Britain, generally, is of the opinion that we wish to challenge her superiority on the seas. She adopted a distrustful attitude toward our proposals at Geneva and, since the failure of that conference because she wanted 6000-ton cruisers with six-inch guns and we argued for 10,000-ton cruisers with eight-inch guns, has consistently shown her distrust of our motives by every means within her power.

Britain, and many people in our country, seem to have forgotten that, when at the time of the Washington Conference we had unquestioned potential superiority in battle cruisers and battle-ships, built and building, we indicated our intention of avoiding competition and the resultant enormous expenditures, and of showing to the world our peacefulness by *voluntarily* calling this conference. We would have gained superiority by simply continuing construction of ships already authorized or building and could have maintained it easily for a long time to come. Instead, we agreed to scrap, and did cut up with electric torches, powerful ships which had cost us many millions of dollars—and sold the scrap for nine dollars a ton! And yet we are accused of militarism!

Early in December when the Congress of the United States convenes (this editorial is being written in November), the second bill to be considered will be the revised Navy Building Program which was held over as unfinished business from the preceding session. This bill, if passed, will authorize the president to undertake, prior to July 1, 1931, construction of one aircraft carrier and 15 light cruisers, cost of the former not to exceed 19,000,000 dollars and of each of the latter not to exceed 17,000,000 dollars. As further evidence of our peaceful intentions, the bill carries the proviso that, "In the event of international agreement for (further) limitation of armaments, the president is authorized and empowered to suspend in whole or in part any of the construction authorized by this act."

Almost coincident with the convening of Congress, the final article of the naval series by Captain N. H. Goss, U. S. N., appears on page 38 of this issue. In letters to us from naval experts and others commending this five-part discussion of naval handicaps and present needs, Captain Goss has been praised as a strategist and student of naval affairs, and not without reason for he is of the younger yet seasoned, energetic, and forward-looking school of officers that is making tradition.

Captain Goss' presentation of the case for the navy is a masterful, correlated array of facts, not specious discursions; and is well worth thorough study by all those, at home and abroad, who are still of the opinion that the Navy Building Program is an aggressive gesture. The United States firmly believes not only that the ships on that program are necessary but also that more are needed, and that our navy should be rounded out into an efficient, perfectly co-ordinated protective machine. Furthermore, an agreement for further limitations should be made, in which case the president could suspend construction accordingly. Therefore, if the revised program passes, the navy will have accomplished only a part of what it hopes to do, and the bill may still be marked: "Unfinished Business."

The Disappearing War-Horse

DESPITE the mechanization of army equipment now taking place throughout the world, the horse has not outgrown his usefulness in war, and cavalry is still indispensable, according to Field Marshal Allenby of England. Himself the most distinguished leader of cavalry during the World War, his opinion has the weight of one who is thoroughly experienced in modern warfare and versed in its methods.

"The work of contact and linking up of units on wide battlefields will still fall to the cavalry," says Marshal Allenby. Airplanes will have their use in distant reconnaisance operations, tanks and armored cars in offensives, and motorized units for bringing up ammunition and supplies, but none of these will take the place of cavalry in certain operations. It is asserted that mechanized equipment will, as a matter of fact, increase the mobility of cavalry. That increased mobility would help prevent, in any future conflict, the deadlocked trench warfare that characterized the World War.

There will be many people—those who have been antagonistic toward our so-called mechanical age—who will be glad the horse has such an able defender. The animal has been a valuable asset to armies since the dawn of history, has held his own against countless new developments, and has always had about him a peculiar romantic glamour. In modern days, however, his race is dwindling and, although he may still be valuable in warfare, it is hardly to be doubted that he will, in time, give way entirely to the onward march of progress.

Not So Hard Boiled

IN this strenuous age ruled by a materialism that kills illusion, gives man no time for dreams, and keeps us on the treadmill, a little glimpse of the sun of romance awakens for a fleeting moment some almost forgotten, almost atrophied fire within us and we feel a warm glow suffusing that intangible part of us we call our souls. When a mighty governmental property bows down to the adventurous whim of a single, officially unimportant person, our appreciation of our fellow man undergoes a change; he can't be so bad, after all.

Recently the Gatun Locks of the Panama Canal were operated for the sole purpose of raising Richard Halliburton, romantic adventurer and travel writer, from the Atlantic Ocean level to that of Gatun Lake on his swim through the canal. The greatest war-ship afloat—the British battle-cruiser *Hood*, of nearly 45,000 tons displacement—used the same amount of water necessary to raise Halliburton; the same gates, weighing 1500 tons each, had to be operated; and Halliburton weighs only 160 pounds!

It is true that this incident took place during the rainy season and the millions of gallons of water used could easily be spared. But the officials responsible for the operation of the locks must have had a spark of adventure within them; they were human beings, not machines bound up with red tape. Officialdom can't be so hard boiled after all.

Diction in "Talkies"

BRITISH national pride in Britain's industrial prestige is cheered. Recent reports have it that, due to "superior diction," she expects to

# of View

lead the world in production of talking motion pictures. Statements to that effect, while not intended to be antagonistic, are to the United States both a challenge and a rapier thrust.

Touché!—exactly on a sore spot, too. Shamefacedly, we must admit that our diction is slovenly. Most Americans have forgotten—if they ever did know—that diction is that department of rhetoric which deals with the choice of words and modes of expression in literature, oratory, and song, and includes articulation, pronunciation, intonation, declamation, and punctuation. The language we use is generally atrocious and our manner of using it blood-curdling; we express our thoughts in the manner of school children and choose our words from the argot of the streets; mouthing our speech and breaking all the rules of rhetoric and grammar have come to be salient characteristics of the American people. And we defend our lazy English with a lofty wave of the hand and the remark: "Oh, but I'm too busy to be bothered."

Whether or not British diction is superior to ours is a matter of personal opinion. If talking motion pictures are measurably successful, however, assuredly there will be an interchange of such films between England and America. Hollywood is already busy improving its diction and therefore it is entirely possible that this consanguineous mating of "tongues" will conduce to the greater beauty and purity of the English language.

Requiem

QUIETLY, without panegyrics, and almost without notice, a famous invention that, something over two years ago, was tried, proven successful, and acclaimed throughout the world, has passed. Anton Flettner's rotor ship is no more. Substitution of Diesel engines for the rotors of the *Baden-Baden*, in a Staten Island ship yard, and a brief notice in a German newspaper announcing the dissolution of the company formed to exploit the rotor, marked its passing.

Hailed at the beginning of its existence as revolutionary and the precursor of a new era in shipping by water, the rotor ship made use of a principle of pure physics. When the rotor towers were revolved by a small power plant aboard ship, and a wind, however slight, struck them, the resultant air currents gave them a forward thrust out of all proportion to the force of the wind or the size of the power plant. And therein lies the hitch. Becalmed, the rotor ship was, like "a painted ship upon a painted ocean," unable to move. And yet the rotors had to be revolved continually in the hope of catching the slightest breeze. Therefore, much fuel might be wasted.

The Practical Touch

RECENTLY we were asked to suggest a scientific play or program that might be presented at a special meeting of a class of boys in a technical high school. We suggested that eight or ten boys of the class each be assigned to read and study a different article in a current issue of some scientific magazine and at the meeting report on it from memory, each boy to be given three or four minutes to cover the more important aspects of his particular subject.

By many educators today, this sort of practical touch with current scientific thought is accepted as necessary but there are others who are like our old history teacher. She made of the study a most dry, uninteresting chore when, by proper presentation, she could have enthralled her pupils. What a chance she would have had to gain our love for the subject by telling, for example, when dealing with Napoleon, the dramatic and intensely interesting story of his son, L'Aiglon; or of many other interesting sidelights on other subjects.

Fundamental theories in science are necessary for the student but if the teacher stops with theories, the student will find, on graduation, that he is out of date. Those educators who recognize this should be commended, but those who do not are out of step with the times and should either get in step or get out.

Had the rotor ship been developed before the day of steamships, its commercial success would have been tremendous. Depending upon uncertain winds, however, and still eating up fuel, it could not, in this modern age, compete with those fast carriers which follow time schedules from port to port.

Vanishing Windmills

THOSE of us who have never had the privilege of visiting the country of Holland are prone to visualize it as a broad expanse of land dotted liberally with picturesque windmills. But science the prosaic, science the practical, seems ready to take this fond illusion from us. Recent reports from this land of wooden shoes and skates, not to mention dikes with holes for heroic youngsters to plug up with their fingers, seem to indicate that the windmills are doomed. Electric power is to replace them, merely because the windmills cannot turn out enough power. Already an international finance company has been formed for promoting the power projects, and so we might just as well change our idealistic mental picture of Holland to a more efficient one of humming electric machinery.

Sane Judgement Needed

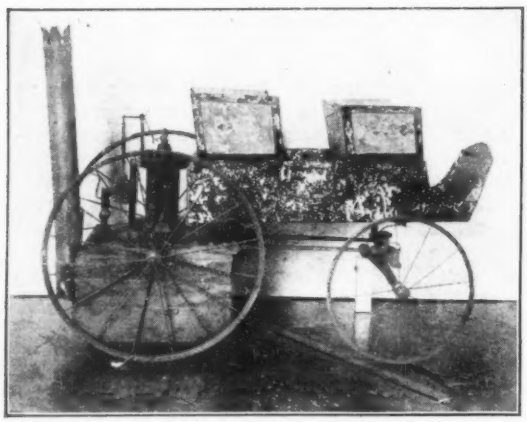
NOW and then someone, previously unknown, announces some discovery or invention that apparently transcends or ignores proven scientific laws. Newspapers play it up with mystifying sensationalism and the poor deluded public gulps and wonders until, finally, the claim is shown to be either fraudulent or groundless.

A few months ago, a motor that was supposed to obtain its power from the void was announced in this country. It was demonstrated, apparently did all that was claimed for it, was written up in great display in thousands of newspapers, and then dropped from sight.

A few weeks ago, papers announced the discovery, by an Englishman, of a metal that counteracted gravitation—that will float in the air. It was claimed that if this metal were used in airplanes, it would hold them up as gas holds up a balloon. Scientists guffawed and demonstrated the phenomenon—with simple magnets! The principle involved is one that may be found in any elementary physics text-book: "Like poles"—of magnets—"repel; unlike poles attract each other."

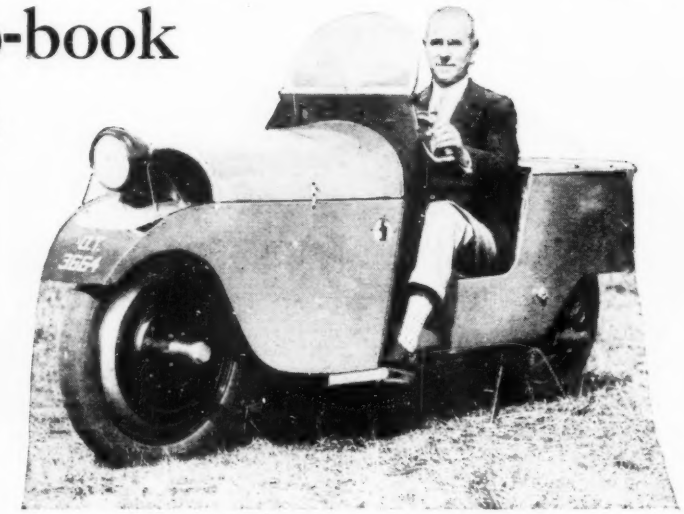
There may have been some excuse for the first claim; for the last there was absolutely none. Personally, we believe the Englishman was having his little joke, was "pulling the legs" of the newspaper men. Unfortunately, the onus fell upon the newspaper readers. Consequently, we would advise a little less credulity when such startling claims are made, at least until they are substantiated by the reports of accredited scientists.

From the Scrap-book of Science



IS IT THE WORLD'S FIRST?

Said to have been conceived long before the era of the automobile, this steam-driven buggy, still in working order, was recently discovered among other relics at the University of Maryland. It was invented by the late Dr. W. E. A. Aiken, Professor of Chemistry and Pharmacy, 1838-1888

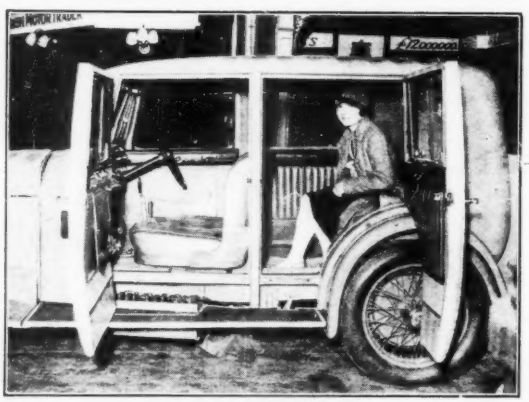


AS COMFORTABLE AS AN AUTOMOBILE

A famous English airplane designer and pilot, A. V. Roe, has built this unique motorcycle which bears a striking resemblance to a small automobile. Its steering gear is similar to that of a car; the seat is upholstered; and it is equipped with a windshield. It is said to be capable of a speed of 60 miles an hour. (See front cover painting)

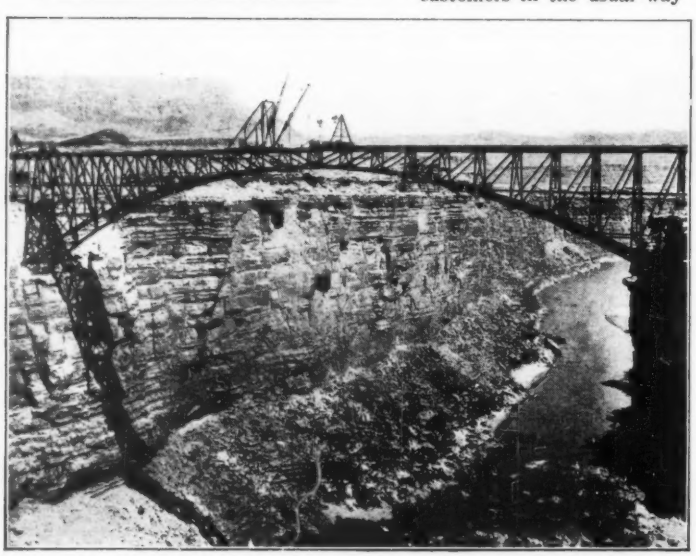
AUTOMARKET

Something new in the way of a "serve yourself" store. The cars of customers pass down one lane while pedestrians use another, each taking what they wish from rotating stands. Goods are placed in carriers and checked for all customers in the usual way



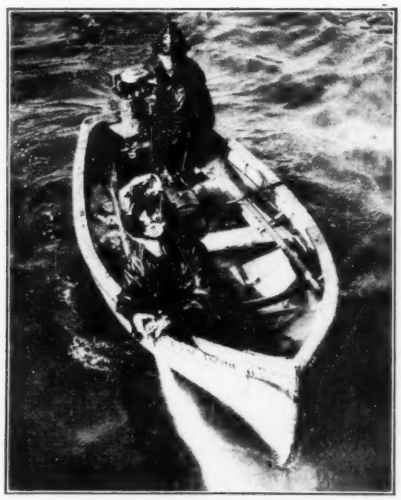
A WIDE OPEN SEDAN

This car with doors of extraordinary width attracted much attention and caused favorable comment at the recent Olympic Motor Car Show in London. As may be seen, both the front and rear doors open wide enough to provide easy access to the interior for the driver and passengers and luggage



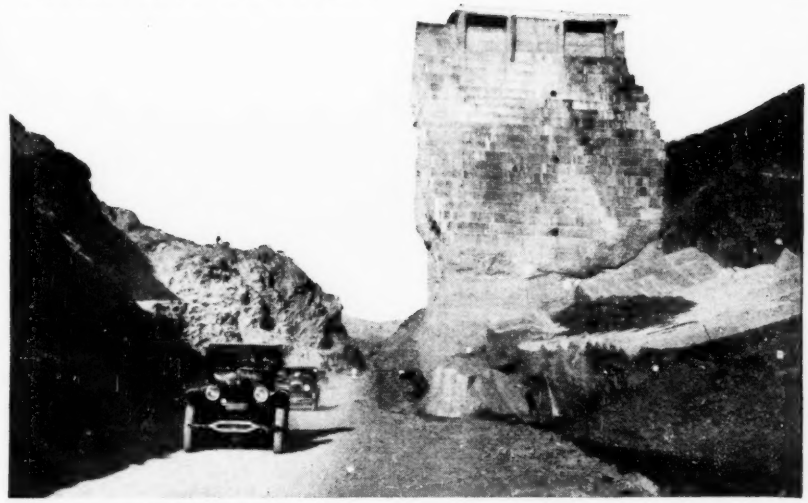
GRAND CANYON'S NEW SPAN

Bridge over Marble Gorge of the Grand Canyon of the Colorado, which will soon be open to traffic. It will be named and formally dedicated June 1, 1929. The 616-foot span was built out from each end and the two sections were joined with a huge pin. The concrete floor is now being laid and the approaches are being built by the Arizona Highway Department



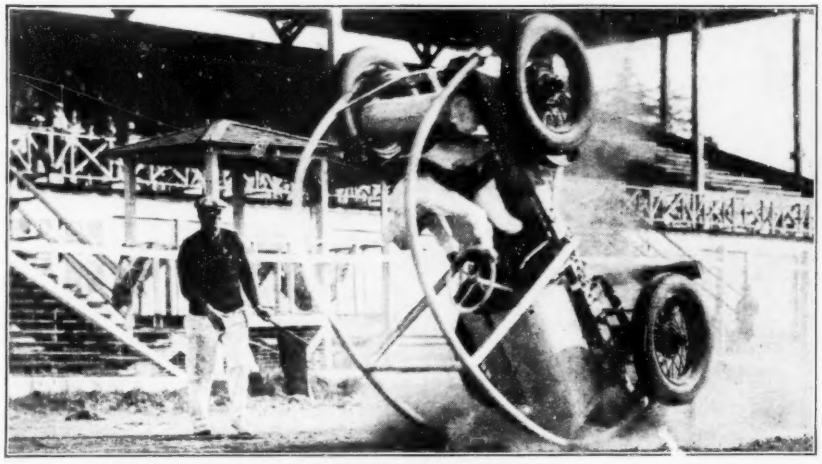
"MOSQUITO" FIREBOAT

One of the small, easily maneuvered fireboats of the Boston Fire Department. It is driven by a powerful outboard motor and is able to dart in and around docks where larger boats cannot go. The pump shown in the center draws salt water from the harbor and sends it through the hose



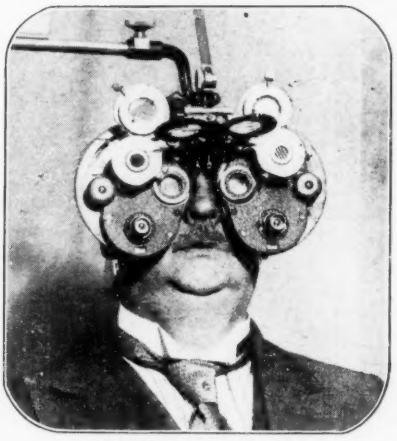
WHERE HUNDREDS DIED

Thousands of autoists now travel a scenic road through the valley, near Los Angeles, where the waters from the collapsed St. Francis Dam took a huge toll of lives early in 1928 (see SCIENTIFIC AMERICAN, June, 1928). The huge central portion of the dam still stands like a grim monument



GRAND-STANDING WITH A TRICK CAR

A 19-year-old girl driver, Miss Estis, photographed in action at Centralia, Washington, as her trick car rolls over on its rockers. The speed of the car at the time of the somersault is said to have been 30 miles an hour. After turning over, the car continued on its way with no more than a severe jolting for the daring driver. It was necessary, of course, that Miss Estis be strapped into the seat

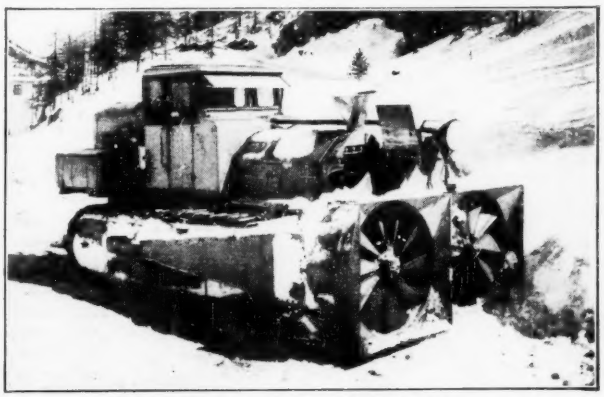


A MILLION LENSES

Although this new instrument installed in the London Refraction Hospital does not actually consist of that number of lenses, the effect is the same for, with it, the optician can secure one million combinations of lenses instantaneously. It is said to be capable of determining the slightest defect in the patient's eyesight

DOUBLE-DECKED MILK DELIVERY TRAILER

To facilitate delivery of milk and allow the carrying of larger loads than heretofore, this new double-decked lorry has been adopted in London. It is equipped with six wheels and the carrying part of the body is similar to the freight trailers commonly used in America at present



SNOW-EATING SNOW PLOW

Literally eating the snow from the roadway that is being cleared, this novel snow plow is used on mountain roads and in the streets of Swiss resorts. The plow, on a track-laying tractor, pushes through soft snow which is drawn in by the turbines and ejected through openings in the boxes at each side. The advantage of this method of snow removal lies in the fact that the snow is not packed

What *Is* Life?

Fascinating Pseudo-cells Which Display the Non-Living Features of Protoplasm May be Made by the Amateur With a Few Chemicals

By EMMA REH STEVENSON

CHOOSING for his field of research for 30 years the borderland between the inorganic and organic world of matter on the fringe of recognized science, Professor Alfonso L. Herrera, chief of the division of biology of the Mexican Department of Agriculture, has obtained curious evidence that may relate to the origin of life upon earth.

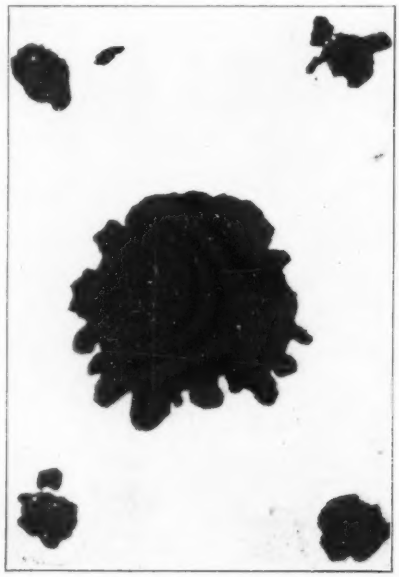
He has taken both mineral and organic substances and created from them pseudo-cells and pseudo-protoplasms that mimic life itself. His microscope has revealed imitation cells that resemble very closely those of living organisms, amoebæ, spores, streptococcus chains, bacteria, and the structure of protoplasm.

PROFESSOR HERRERA makes no extravagant claims. He merely shows that the mysterious activities of life cells and the special forms and shapes of living substance can be imitated by common mineral and organic materials that do not possess the so-called life force. He therefore believes that life is not a special phenomenon, but a property which all matter possesses under the right conditions.

Perhaps the most interesting of all of his "artificial beings," as Professor Herrera calls his imitation cells, are his "colpoids" which resemble both in appearance and in behavior the creatures called amoebæ by scientists.

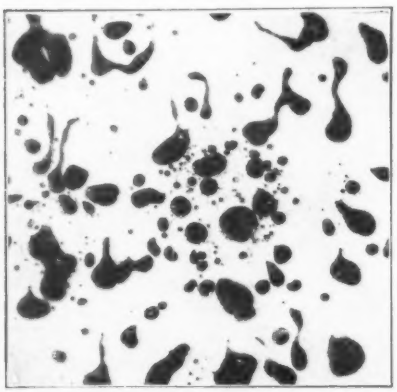
He treats the visitor to his laboratory to a sight of the antics of his favorite laboratory "children." He dissolves 50 parts of olive oil in 100 parts of gasoline, and 14 parts of soda lye in 100 parts of distilled water, adding a pinch of aniline black to this latter solution so that the observer can distinguish the two.

The oil-and-gasoline solution he puts into a porcelain dish with a flat bottom which he levels mechanically so that any movements in the liquid will not be due to gravity. With an eye dropper he takes a small amount of the black soda solution and inserts it under the surface of the gasoline-oil mixture. Then he hands the visitor the magnifying glass.



THE EXPERIMENT

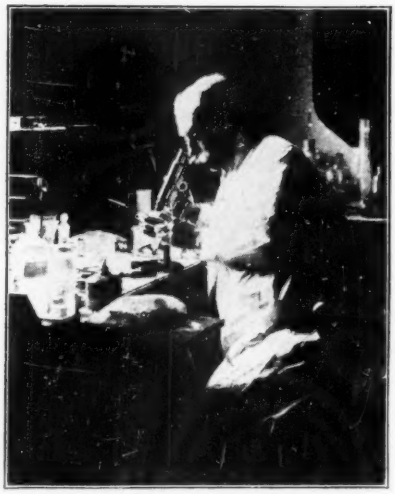
The several ingredients are mixed, and a drop of the soda solution "comes to life"



THE SECOND STAGE

One large drop breaks into rapidly moving parts which shake and tremble

Almost immediately things begin to happen. The black drop becomes alive and begins to sway and tremble and shake itself. It begins to pant and breathe and divide itself into parts. These parts begin to skip around rapidly in a dissatisfied manner, pursuing, evading, and battling with other droplets for their bodies. They extend armlike appendages and fight vampire fights.



PROFESSOR A. L. HERRERA

In his laboratory at the Mexican Department of Agriculture where he experiments

They act for all the world like real single-celled living creatures going through the ordinary routine of life. They "eat" and "reproduce" like the amoeba swimming in a pond looking for its daily bread and peopling it with other amoebæ.

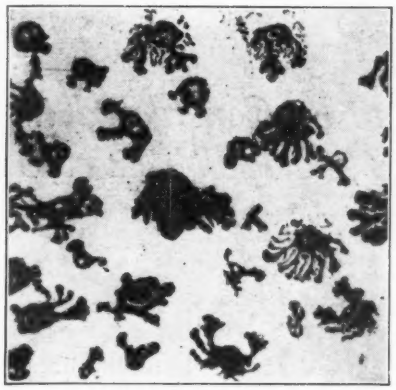
Professor Herrera does not claim that his oil-and-soda creatures are alive, for he can explain their strange life-like antics and amoeba-like shapes by well-known chemical and physical theories. The oil-and-soda solutions react according to the chemical process of saponification, a process the housewife used to take advantage of when she made her own soap, using rendered animal fats and leached lye from wood ashes.

WHEN a drop of the black soda solution is placed in the oil mixture, saponification immediately begins to take place around the outside of the drop, forming a thin membrane of soap around it. Then there is a black solution of one nature wrapped in a delicate bag and suspended within another solution of an entirely different disposition and character.

The soap bag which encloses the soda drop, like the membranes that envelop animal and vegetable cells in real life, is semi-permeable, and permits certain molecules to pass through. A social war of equalization takes place in an effort to make conditions on the inside of the drop more like those on the outside.

The equalization struggle is the process of saponification. Under the microscope this ordinary struggle of one solution on the outside looking in with the other one on the inside looking out, is fascinating to watch.

Tiny currents of excited material seem to be streaming through the pores of the membrane, and an active interchange of material is seen to be taking



THE THIRD STAGE

The parts begin to assume a pseudo-resemblance to amoebæ. Still active

place. Movements are set up within the black drop which change its shape every moment. As the battle between the two sides progresses, the composition of the black drop is changing and saponification is increasing.

The speed with which the soda cell runs through its allotted time depends on the temperature of the reacting solutions. At about 50 degrees, Fahrenheit, the mortal struggle lasts about 45 minutes and then the imitation cell lies spent and quiet, and has changed from an exciting "creature" to a little bit of soap.

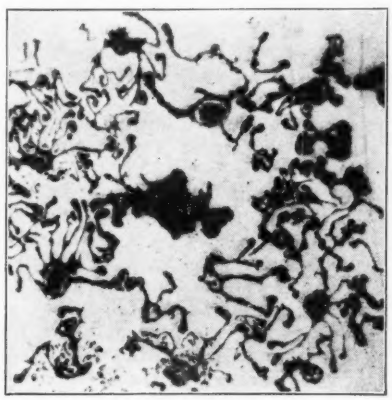
OTHER forces besides those of osmotic pressure come into play in the lives of his colpoids, Professor Herrera explains, and these are the physical forces of surface tension and the electrical charges on the surface of the drops which have so much to do with their likes and dislikes of each other. Surface tension forces the drop to take the spherical form as the most economical shape, but the currents caused by the chemical interchange of material are forever modifying its figure.

In order to study these various forces further, which Professor Herrera believes are analogous to those taking place in living cells, he suggests a curious experiment for some future scientist to perform who is interested in this neglected field for research. He suggests an artificial lake of gasoline and oil in which a large amount of black soda solution might be suspended. The physical forces and electrical properties of the reacting bodies could then be better measured because of their enormity, he believes.

Professor Herrera's colpoid or artificial cell of soda and oil is perhaps his most spectacular artificial "creature," but he has mimicked many other structures by means of other chemical substances. His first experiments were with organic substances such as tannin, oleic acid, albumin, and fats, but he discovered that his best results were obtained when certain mineral impurities, such as soluble silicates, were present. In course of time he succeeded in obtaining on his microscope slide structures resembling isolated cells, spores, streptococcus chains, bacteria, and protoplasms.

One of his simplest methods of preparing a pseudo-protoplasm in his laboratory today is by sprinkling a bit of Merck's chemically prepared powdered egg albumin upon a drop of nitric acid on a microscope slide. Remarkably realistic structures arise which appear almost identical with the structure of living protoplasm. By varying the acid, Professor Herrera can vary the type of protoplasmic structure.

"These various experiments are not without biological significance," Professor Herrera states. "The reproduction of such structures and their identity with the morphology of living protoplasm and living cells indicates



MORE ACTIVITY

The "amoebæ" have extended their "pseudopods" still farther. They still move

that the physical basis underlying the two must have much in common. And I believe the parallelism exists from the chemical point of view as well.

"Of the two theories of the origin of life, the one which holds that it has its beginnings in inorganic rather than organic substances is easier, for organic substances are hardly conceivable in a primitive world.

"I do not pretend to have proved through my experiments that such has been the origin of living things on earth, but I do believe that I have at least obtained evidence in that direction.

"The combinations of solutions produced by the reaction of water and the earth's atmosphere with the constituents of the soil, are able to produce all the cellular structures which I have produced in my laboratory," Professor Herrera says.

He sees an inescapable parallel, with inescapable conclusions, between the artificial creatures of his laboratory and structures in real life. The amoeba moves about in its pool of water by the streaming of its body substances, and it extends arm-like appendages which scientists call pseudopods, in order to get its food.

In the arm-like extensions of the black soda drop which it uses to get a vampire grip on its rivals, Professor Herrera sees the counterparts of the pseudopods of the living amoeba in the brook. And in the pseudopods of the amoeba he sees the foreshadowing of arms and legs in the various higher forms of life.

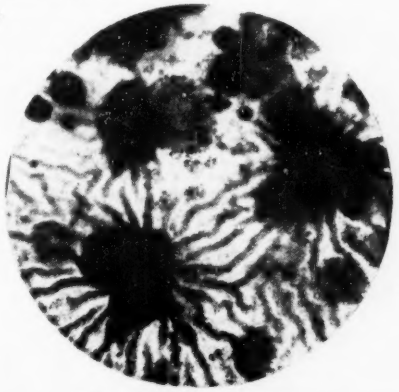
The simple amoeba glides about in its sunny pool, taking up what things it likes for food as they come within its reach. If they are few and far between, its excursions become wider and faster.

The tiny water-hydra, simplest multi-celled thing, awaits with its appendages the arrival of its prey. When none arrives it merely changes its shape and its position and lies in wait once more.

THE caterpillar born on the trunk of a tree crawls to the branches to reach the leaves on which it feeds. As the scale of life is ascended and the behavior of the organism becomes more and more complicated, the various physical and chemical reactions become so confused with what are called instincts, at the bottom of which they must lie, that they are completely lost sight of.

The struggles of a man to get food by robbing a bank or getting a job in another factory are as much the result of internal chemical reaction as the behavior of the caterpillar on the tree, the hydra in the brook, the amoeba in the sunny pool, or the excited black drop skipping about under his microscope, Professor Herrera believes.

Professor Herrera's conclusions are the result of 30 years' work in which time he has made nearly 6000 experiments in this field of hitherto uncredited research, and which is beginning to attract the attention of many authorities in various parts of the scientific world.



PSEUDO-CELL DIVISION

This resembles an illustration of amoebæ division found in Smallwood's Biology

Where To Put It?

Few Realize How Many Factors Will Have to be Considered in Selecting Scientifically the Best Site for the New 200-Inch Telescope

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

AS these words are written the main topic of astronomical interest is, beyong question, the great telescope which is to be constructed for the California Institute of Technology. So much has been written about it, and so much more will doubtless appear before these lines see the light, that the main outlines planned will already be familiar to our readers.

Nor is there any reason to explain why an increase of telescopic power will be of value to science, nor to fill a page with a detailed statement of what the 200-inch reflector may do when it is in operation. The problems which arise at once and must be solved by the astronomers who are responsible for the new observatory are of equal interest and more pressing in importance. With so much at stake every detail must be most carefully weighed.

For example, it is already announced that experiments are in progress looking toward the construction of a disk of fused quartz for the great mirror. Since the coefficient of expansion of this material is about six percent of that of glass, the perennial difficulties which arise from the distortion of the glass mirror by unequal changes in its temperature should be greatly diminished. A quartz mirror would, therefore, be far superior to any other, but the task of melting and casting tons of this highly refractory substance into a flawless disk will tax the highest engineering skill. Other important problems of engineering, although more familiar, will include the construction of the mounting, the great piers, the skeleton tube, and the devices for moving it both uniformly to follow the stars and at will for setting.

A NUMBER of economic factors complicate the matter. Should the new telescope be in its general proportions a larger replica of the 100-inch, it would be twice as long and require a dome approximately twice as big. To build this is practicable but would be exceedingly expensive. If, however, the mirror is designed with sharper curvatures, so that the focal length is smaller in proportion to its diameter, the cost of dome and mounting will be reduced.

But here, of course, there are still more important factors to be considered. With the shortened focus the brightness of the erect image of a nebula (for example) will be increased and this is an obvious advantage. But everything has its drawbacks and in this case the field of sharp definition is smaller. A parabolic mirror, if accurately figured, gives an admirable image of a star on its axis of symmetry, but for stars whose light falls on the mirror at other angles the images are less perfect.

A star half a degree from the center of the field gives a fan-shaped image which cannot be brought into sharp focus by any adjustment. The fault is not with the instrument, nor does it come from the wave-properties of light. It is a direct consequence of the geometry of reflection from a curved mirror, and it is easy to show that no possible form of surface could improve matters for stars at the edge of the field without spoiling the image at the center.

THE shorter the focal length compared with the aperture of the mirror the worse will this difficulty be, and the smaller the field of passably good definition. Here, then, a compromise is in order, and a decision to make the focal length about three and one half times the diameter has been reached, after careful consideration of all the financial and optical factors which are involved.

Still more important is the problem of the observatory site, and here again technical, economic, and human considerations all come into play. The first requisite is obviously that the climatic conditions shall be the best available. The necessity of the maximum number of cloudless nights during the year would be recognized by the uninformed, and a very little astronomical knowledge enables one to add the requirements that the air shall be both transparent and steady.

We who live at sea level, especially if we dwell near cities, hardly realize how clear the sky can be. We are so used to a more or less hazy or dusty atmosphere that we think it is natural to see long "rays" of light where the sunbeams come through breaks in the clouds. But in really clear air these beams almost disappear. A simple test, and yet one of the best, is to hide the sun behind the edge of the building, or even the hand, and note how much the sky brightens near it. Under ordinary conditions in the east a conspicuously bright whitish cast will be seen extending several degrees from the sun and brightening still more close to it.

But under really clear skies all this is absent and the heavenly blue extends right to the sun's edge—a little brighter indeed but not perceptibly altered in color. Such clear skies are very rare here, although they may occasionally be seen. To find them often we must seek regions where the air is not befouled with smoke or thickened with haze. Sometimes they appear at sea level (as the writer noticed off the coast of Norway last summer) but they are found in perfection at high altitudes. On a mountain top, or for that matter in an airplane, one gets above the lower and denser layers of air which carry almost all the dirt, and the sky is darker as well as bluer.

There is a limit to the gain which can be made in this way, for the molecules of the air themselves scatter light and a certain degree of sky brightness is therefore unavoidable. The measures of Abbot on Mount Wilson show that this theoretical limit is very nearly reached there under good conditions, and there is every reason to believe that at many other stations the air is also often as clear as air can be.

IF we could find a mountain 20 miles high, make a way to its summit and contrive to live there after we reached it, we might do better. In practice, however, the gain by going up more than 10,000 feet or so is offset by other conditions.

Steadiness of the air is even more important than transparency, especially for a great telescope. The larger the instrument the broader is the column of air extending to the top of our atmosphere through which the light of a star passes, and the greater is the chance of picking up trouble. If anywhere in this column there are masses or streaks of air of unequal density these will deviate the light by their refraction. The rays which arrive at the telescope will not all be parallel; and no mirror, however perfect, can bring them to a sharp focus. The image will be distorted and fuzzy, and moreover will dance and "boil" as the wind sweeps new air bodies in the path of the rays. When the air is full of larger rays of this sort, such as those which produce the aviator's "bumps" or "air pockets," the images become

so bad that it is little use to attempt observation.

It is of vital importance, therefore, that the new telescope should be situated in a region of settled weather, out of the normal tracks at least of the great cyclonic storms which sweep over the northern and central parts of Europe and the United States. The southwestern part of the country is best situated in this respect.

But local as well as general conditions enter into this matter of "seeing." A sharp mountain peak is almost sure to be bad, for ascending currents of air rise from the slopes below by day. A narrow valley catches cold descending currents by night. The most favorable chances are to be expected on a high plateau on the top of a broad-backed mountain. For similar reasons a forested mountain is preferable to a bare one, and fields of bare rock which are strongly heated by the sun are to be avoided.

Principles like these narrow down the choice a good deal. But as in all matters of weather, exact predictions cannot be returned. The only way to settle the question as between the more promising sites is to have actual observations made by a skilled observer, and with a telescope of moderate size or with the interferometer. Since the *average* conditions throughout the year are decisive, such observations must be made on many nights in all seasons. To make adequate tests of this sort at many places will be one of the most important and the most time consuming things that lie before the investigators.

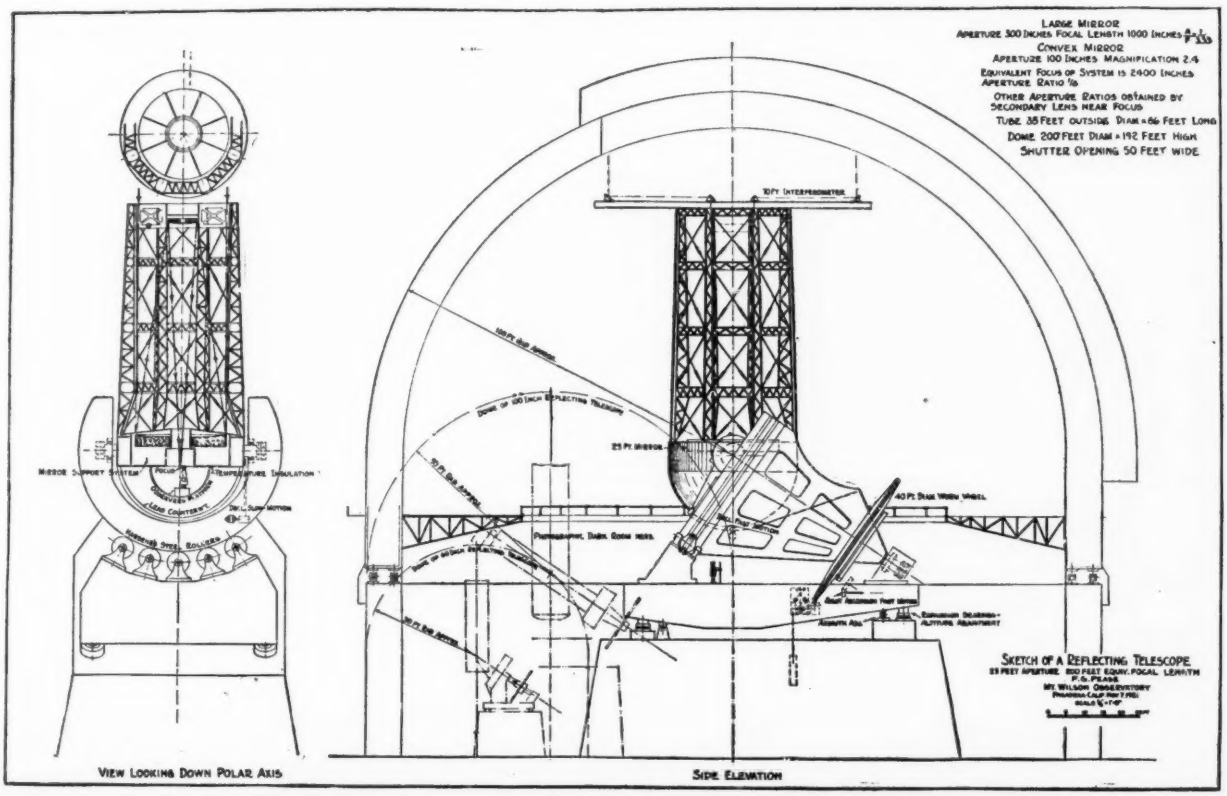
But the problem is not solved merely by finding good observing conditions. These, in the mathematician's language, are "necessary but not sufficient." The site must be accessible. One remembers the story of the mining engineer sent to investigate a claim which the discoverer offered for sale suspiciously cheap, who telegraphed back east "Ore there. Up to sample. Lots of it. Will need pack train of bald eagles to get it out." The road up Mount Wilson cost a hundred thousand dollars, and a site which is too costly must be dropped from consideration.

THE observatory must be located, also, in a habitable place. Although the astronomers will doubtless come for observing "spells" of a few days, returning to work up their photographs while others take their places at the telescope, a staff of mechanical and other assistants will establish their permanent homes close to the great dome.

Finally, there is an economic problem of a different sort—not of money but of time. The relation of the new observatory of the California Institute makes it certain that the central offices—the Astrophysical Institute at which the observations will be reduced and the theoretical work done—will be on its campus in Pasadena. The experience of the Mount Wilson staff shows that no inconvenience is caused by having the observatory two hours run away over a hard mountain road. Indeed, when the first telescopes were erected there the trip was made on horseback or on foot and took much longer. With present means of transportation a distance of a hundred miles need not be a serious obstacle, but a whole day's journey by rail would be a different matter.

It has been tentatively decided, therefore, to place the great telescope within a night's ride or thereabouts from Pasadena. This still leaves a very large extent of country open for investigation, including the best climatic zone (astronomically speaking) in the United States, and a great variety of topography. It will be a good while yet before the question can be settled.

This is by no means an exhaustive survey of the factors which must be considered. But enough has been said, perhaps, to show that if the plans for the new observatory seem to be hanging fire, this will be far from indicating that nothing is being done. A great deal of hard labor must be put in, even before the land is bought and the ground broken.


LARGE MIRROR
CONVEX MIRROR
OTHER APERTURE RATIOS OBTAINED BY SECONDARY LENS NEAR FOCUS
DOME 200 FEET DIAM. × 192 FEET HIGH
SHUTTER OPENING 50 FEET WIDE
SKETCH OF A REFLECTING TELESCOPE
VIEW LOOKING DOWN POLAR AXIS
SIDE ELEVATION

BASIC DESIGN FOR THE 300-INCH TELESCOPE, AS PROJECTED TWO YEARS AGO

The same type of mounting will be used for the 200-inch telescope. This split-ring equatorial type, turning in right ascension on rollers, was first described by Russell W. Porter, in *Popular Astronomy*, 1918. In the Porter "garden" telescopes it proved successful

Courtesy The Reading Company

A MONSTER OF THE ROAD

The Reading Company has a well-organized, supplemental highway system

Railroads Turn To the Highways

To Protect Revenues and Give Better Service, Steam Railroads Adopt Motor Buses

By F. D. McHUGH

MOTOR coaches—or motor buses, as they are more commonly designated — have been used for interurban or cross-country service only a few years, but now they travel on regular routes that form a fine network covering the entire country. In the early days of bus travel, the service was mainly local, the transportation companies then in operation being usually of a "wild-cat" type, and more or less irresponsible. The lines ran for short distances between small country or suburban towns, the schedules were unreliable, rates were arbitrary and sometimes unreasonable, and often, in case of a bus breakdown, the passengers were left to shift for themselves and get to their destinations as best they might.

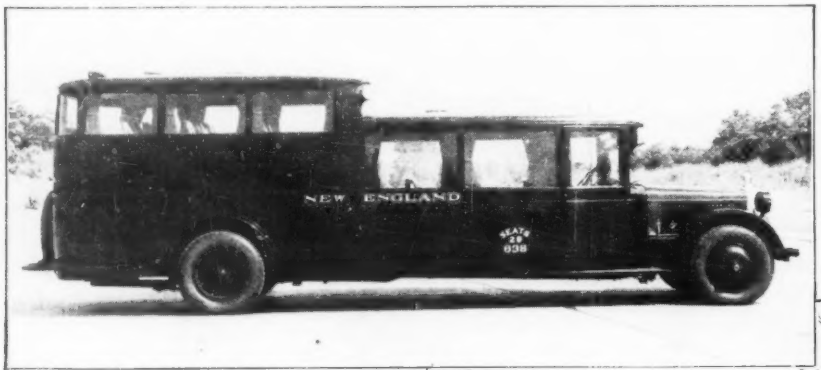
One of the first uses of buses for longer runs was on scenic routes or tours. Their operation was profitable in this service, and bus lines gradually began to branch out in all directions, meeting and crossing each other, and continually expanding. As the public acceptance of them as a legitimate mode of travel became more general and profits began to show, consolidations were effected, the "wild-cats" and local transportation companies began to disappear gradually, and responsible companies which maintained schedule service over fixed routes at definite, more reasonable rates, took their place. Now practically every highway near the larger urban centers and in thickly populated districts, has its motor-bus line, while lesser highways and towns can also boast possession of one or more bus transportation companies.

Not only do present bus lines cross and re-cross each other, but many of them parallel rail lines in direct competition with steam railroads. This competition has been greatly extended in recent months by the inauguration of overnight lines, the buses of which are built somewhat on the order of a railroad sleeping car, with berths and all the appurtenances necessary for a continuous trip of several days' length. Such a bus was described in SCIENTIFIC AMERICAN, October, 1928.

With characteristic conservatism, the railroads for years looked askance upon the competing highway transportation lines. Private automobiles had already taken a great deal of business from the railroads and bus lines, if successful on any large scale, promised to carry many more former railroad passengers. Railroad officials became uneasy. Some thought that the railroad should stick to the rails and meet bus competition by better service while others believed that the railroads would, in the end, have to operate their own highway lines.

THE logical and, we might say, inevitable outcome was that many railroads decided to follow the latter course.

Thus in the United States, there are at present, according to "Facts and Figures of the Automobile Industry," published by the National Automobile Chamber of Commerce, 67 steam railroads using motor buses. Some of these are operated by the railroads themselves, others by subsidiary transportation companies formed and entirely owned by the railroads, while others are operated on contract by outside companies. The routes covered are: new feeder lines, lines substituted for unprofitable branch steam lines,



Courtesy New York, New Haven and Hartford Railroad

PARLOR OBSERVATION COACH

Under the elevated observation section of this motor bus is space for the luggage

Courtesy Boston and Maine Railroad

THE RAILS ARE OUT BUT THE BUSES GO ON

During the flood of November 3-5, 1927, in New England, many railroads were washed out. Buses were running in a short time because the roads could be opened sooner than the rails

and on highways paralleling rail routes.

The feeder service is exemplified by the bus lines operated by the Fifth Avenue Coach Company for the Baltimore and Ohio Railroad Company from the Central Railroad of New Jersey terminal in Jersey City to New York and Brooklyn. The parlor motor coaches on this line run from the train-side, cross on Hudson River ferries, past some of the larger, well-known hotels in Manhattan to the ticket office and waiting room maintained opposite Grand Central Terminal; and across lower Manhattan to Borough Hall, Brooklyn. Twenty-two buses are operated in this service which is run without extra cost to rail passengers.

THE Boston and Maine Railroad reports that it operates 92 buses over approximately 1200 miles in Massachusetts, New Hampshire, Maine, Vermont, and eastern New York. For the first nine months of 1928, they operated 1,844,987 miles compared with 1,719,765 miles during the whole of 1927. These figures indicate that there is no slowing up of railroad-bus service but, instead, there is rapid growth. Their buses are used to eliminate stops of steam trains and thus speed up train service; for supplying service to communities formerly without service of any kind; for summer tourist service; to replace unprofitable street railway lines; and for special party work—in addition to feeder lines and substitution on branches.

The Reading Company now operates 30 motor buses on 11 lines which total about 255 miles—relatively a small system—but their annual mileage is 850,000 and their schedules number 184. This company uses motor buses for the purpose of maintaining frequency of service and to increase it where the traffic does not warrant such frequency by the steam trains. Its buses operate in co-ordination with the schedules of steam trains but are otherwise independent of rail lines.

The New York, New Haven, and Hartford Railroad Company, said to be one of the pioneers and also the largest railroad operator of buses in the east, now has a highway transportation system (subsidiary) that boasts 270 buses. Twenty-one of its 50 lines are classed as "rail savers," 23 as supplemental to rail, and six as summer lines. During 1927, its buses carried 4,248,287 passengers and were operated 6,682,355 bus-miles.

Courtesy Boston and Maine Railroad

THE OBSERVATION "PLATFORM" OF A DE LUXE BUS

The roomy interior and comfortable seating arrangement of a large motor bus showing the steps leading to the observation section in the rear. Buses of this type are used on long runs

Courtesy New York, New Haven and Hartford Railroad

LIKE A REGULAR RAILROAD STATION

Some of the larger railroad operators of buses have established waiting rooms and ticket offices for bus passengers. The station shown is particularly well-arranged and comfortable

THE larger railroad operators of buses have regular time-tables, comparable in size and completeness with those used for regular steam trains; separate passenger ticket offices and waiting rooms; and their own garages and full-time salaried mechanics. Passengers for other lines, not necessarily the smaller, use the regular railroad stations. Usually, except in cases like that of the New York City feeder service of the Baltimore and Ohio Railroad Company, railroad tickets cannot be used on buses although the rate on the buses averages about the same as that on the steam trains, or 3.6 cents a mile.

In this discussion, only a few examples have been given to show the extent of highway transportation systems now operated by railroads and to show how the service rendered by these lines has grown from nothing in a matter of less than 10 years to an immense nation-wide business. It is sufficient to indicate the trend of thought among railroad officials and give a promise of what is to come. The success in this service, of the railroads mentioned here, and the fact that they and other far-sighted ones are continually adding to their fleets of buses, points conclusively to the fact that, in time, practically all railroads will operate buses in highway service.

Robots for Salesmen

Big Business Lays the Foundation for the Age of Mechanical Distribution of Merchandise

By MILTON WRIGHT

JOSEPH J. SCHERMACK

About this prolific inventor is built a 25,000,000 dollar corporation to install automatic vending machines everywhere

THE industrial era in which we live is characterized to a great extent by ever-advancing steps to relieve men and women of mere mechanical duties and leave them free to concentrate upon tasks which require thought. "If something can be done by machinery, let a machine do it," has been our motto for some years past.

That this is the keynote of our *industrial* progress is self-evident. It now becomes the principle for *commercial* progress. Why have a high-priced human salesman perform the mere mechanical task of handing out a package of cigarettes, receiving a quarter, dropping your money in a cash drawer and passing back to the customer ten cents in change, a paper of matches and a profit-sharing coupon? Why not have automatic equipment to do this automatic work, permitting the man behind the counter to induce the customer to buy a $2.50 pipe, thus being a salesman in fact as well as in name?

THAT is precisely what is now about to be done through an overshadowing 25,000,000 dollar corporation which has recently been founded, including in its affiliation one of the best known inventor's laboratories in the country, one of the best known arms' manufacturers, the leading chains of cigar stores, the vending machine manufacturers, and candy, drug, and novelty stores.

At the very center of this development, as at the center of most great developments, stands an inventor. In this case it happens to be Joseph J. Schermack, the man who has done more to make automatic vending machines a commercial success than has any other man in this country. Mr. Schermack is president of the new Consolidated Automatic Merchandising Corporation. Like many geniuses who have built up large enterprises he has become associated with a financier. In this case it happens to be A. J. Sack, who is Chairman of the Board of Directors of the new corporation.

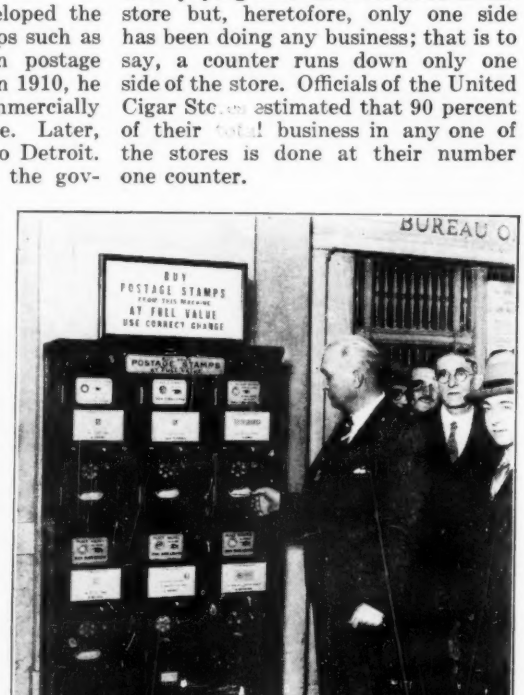
We called upon Mr. Schermack to learn his story. It was the typical story of the inventor with mechanical ability and business ability combined, beginning in humble circumstances at an early age and working his way up to success. At the age of thirteen, he had started to work as a mechanic in a factory in Freeport, Illinois. In 1900, he went into business for himself making mailing machines. The first of these he placed with Marshall Field and Company in Chicago.

Five years later, he developed the roll device for postage stamps such as is now used extensively in postage stamp vending machines. In 1910, he brought out the first commercially practical stamp selling device. Later, he transferred his business to Detroit. He developed and induced the government to provide the roll form of postage stamps, now in general use for commercial purposes in a variety of mailing and stamp selling machines.

"We have 30,000 commercial stamp-selling machines in operation in the United States, in hotels, drug stores and other places," Mr. Schermack told us, "and eventually we will have a hundred thousand. At first, we sold these machines outright to the stores in which they were used. Later, we abandoned this principle and placed them in the stores on a profit-sharing basis. Thus, in every Liggett's drug store we installed a machine, which the Liggett Drug Company keeps filled with stamps and collects the money; then they send us our portion of the profits. About the same method of operating will be applied to all devices controlled by our present consolidation. The ownership of the new merchandising machines is to be retained by our corporation."

We began to discuss the first of the new types of machines which the new corporation is bringing out. This is the slot machine which delivers a pack of cigarettes, a coupon, and a paper of matches and says "Thank you" to the customer who has dropped his money in the proper slot.

THE use of such machines, we learned, was a logical development of the cigar store business. There was a need to give more display room to the goods and at the same time more room on the counters to the salesmen. The cigar stores always were paying rent for both sides of the store but, heretofore, only one side has been doing any business; that is to say, a counter runs down only one side of the store. Officials of the United Cigar Stores estimated that 90 percent of their total business in any one of the stores is done at their number one counter.



IT DOES THE WORK OF ONE MAN

In the New York Post Office the automatic stamp seller leaves one clerk free to perform more important tasks

While Mr. Schermack and Mr. Sack were thinking along these lines and planning for automatic machines to relieve the salesmen, the United Cigar Store officials were thinking along the same lines. Let us interrupt our interview with Mr. Schermack at this point and recall an interview with Mr. A. Granat, Vice President, United Cigar Stores Company, on the same general subject.

"Why could we not have a battery of vending machines instead of a lot of mirrors on the side of the store opposite the counter, was the question I kept asking myself," Mr. Granat said to us.

"We could put them in shadow boxes and light them up and customers would be attracted to them. The problem was to get the right kind of vending machines. For two and one half years I talked to all kinds of inventors and I got every conceivable kind of vending machine, except the kind I wanted. A gravity drop machine, for example, would not be effective because of the different sizes and weights of the packages. Then, too, all of the inventors wanted to be financed, while I was looking for someone who would finance his own invention.

BUYERS ON TWO SIDES

In most cigar stores one side is a loss. With slot machines the wall space pays a profit and the clerk behind the counter can do real selling, not being bothered by trivial time-wasting routine

"FINALLY, I got in touch with the Sanitary Postage Service Corporation. They came in with a proposition to put a coin-controlled vending machine in a cigar store at their own expense, which they estimated would not be more than 10,000 dollars."

"Why do you select cigarettes to put into these vending machines?" we asked.

"Because cigarettes are necessarily unprofitable. When you figure that the grower gets about six cents for the tobacco that would go into a package of cigarettes and that the consumer pays only fifteen cents, you can see that in that difference of nine cents out of which must come manufacturing cost, advertising, distribution, and everything else, there is not much opportunity for profit. Therefore, they were considered the logical thing to vend through the machines.

"We developed a machine and put it into a cigar store at 33rd Street and Broadway, New York City. I was in there one day to see how it would operate, when one of the customers in the store, a stranger to me, said: 'I suppose that will pass out the cigarettes all right, but I will miss the "Thank you" that the clerk always says when he gives me my change.'

"That was what was needed, a machine which could not only sell, but talk. We set to work on the machine and with the aid of one of the best-known manufacturers in the country we developed an apparatus which would say 'Thank you' and repeat the slogan of the particular brand of cigarette every time a sale was made. Thus, if you dropped 15 cents in the proper slot for a package of Lucky Strikes, a voice would say: 'Thank you, they're toasted;' or if your choice was Chesterfields, it would say: 'Thank you, they satisfy.'

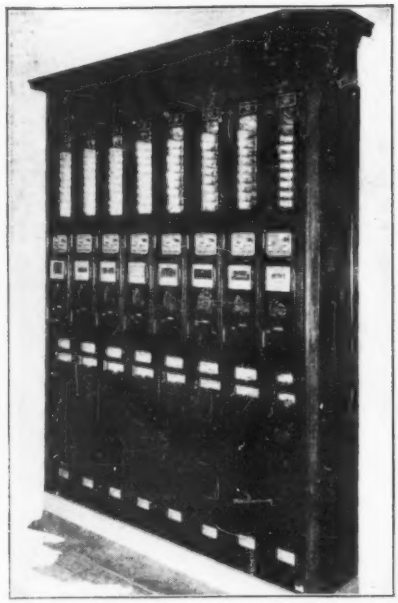
"After we got the company started, we began to discuss the probability of consolidating the different aspects of our business, namely, the manufacturing, the servicing, and the selling. Therefore, we formed the general organization we now have, which overshadows all of the companies which heretofore have been engaged in the business of vending merchandise by machines. This included the Automatic Merchandising Corporation of America; the General Vending Corporation; the Sanitary Postage Service Corporation, and the Schermack Corporation of America. The Remington Arms Company was already in the field as a potential competitor and we drew them into the fold."

Now to return to our interview with Mr. Schermack.

"Have you taken out any patents for these new talking merchandising machines?" we asked him.

"Nine patents are pending," he replied. "There are three main features in this equipment which, I believe, are novel. In the first place, these vending machines are designed to handle articles of any shape because of the endless chain of buckets. Their greatly increased capacity makes them now suitable for commercial purposes. The ordinary automatic vending machine has a limited capacity of 25 packages, while the endless bucket chain principle used in the present machine, permits a hundred packages to be loaded into the device, which will deliver not only the package of cigarettes, but also give certificates and matches and change, when necessary.

"Then the coin-control feature is novel also. It can handle from one to three coins of any denomination, exposing all of the coins, both before



READY FOR BUSINESS

A large capacity for each stack permits continuous operation without refilling

and after the operation. The nature of these coin controls is such that they are easily interchangeable for various amounts and denominations.

"In the one United Cigar Store in which we have installed the new type of merchandising machine, there are fifteen units for merchandise and change making.

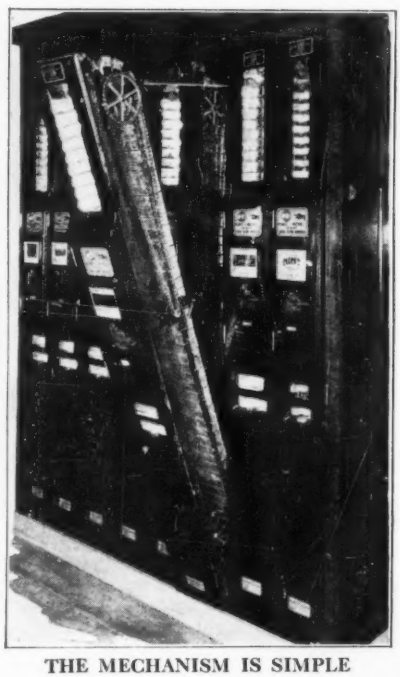
"The most interesting feature of our automatic merchandising system is the combination of talking and automatic vending machine, a combination no one, apparently, ever thought of until recently, and upon which we expect patents will be issued shortly.

"ANOTHER patentable feature which never seems to have occurred to anybody so far, is to have the phonograph needle travel in a circle on the phonograph disk instead of in a spiral. This permits endless repetition of the one brief message; the disk stops, then repeats when the next customer comes along. This idea of the circular movement instead of the spiral is simple in itself; yet, no one has thought of it. The patent claims on this we expect to be extremely broad."

To complete our picture of the new enterprise we had a chat with Mr. A. J. Sack, the chairman of the Board of Directors.

"When I met Mr. Schermack in the early part of 1924, his accomplishments were already impressive," said Mr. Sack. "He had invented and designed the well-known sanitary postage machine, and succeeded, by that time, in placing about eight thousand of them on the market, thus proving that automatic postage service, because of its convenience and cleanliness, is readily accepted by the merchants and the large buying public.

"I was further impressed by the marvelous preparatory work which he has done in applying the principle of automatic service to the large and important Post Office field. He invented a device, an automatic postage machine for Post Offices, which would sell, at cost, one cent, two cent and five cent stamps in various combinations, as well as stamped envelopes, stamps in book form, and postcards. In discussing this part of his work, I was deeply impressed by the meaning of this service which would not only relieve the Post Office pressure during rush hours, but would also serve the public in the evenings and on Sundays and holidays, when the Post Office windows are closed. In addition, it would save the Post Office Department millions of dollars yearly.



THE MECHANISM IS SIMPLE

With few parts and sturdy construction the slot machine does not get out of order

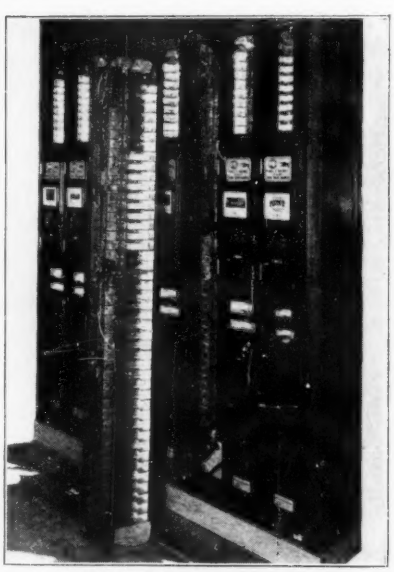
"As our relationships and friendship developed, we found ourselves in full accord as to the understanding that this country is entering the automatic age. Our relationships culminated in my accepting the position of Vice President and Executive Director in the Schermack Corporation of America and in the Sanitary Postage Association of America, for the purpose of helping in reorganizing these two companies and preparing them for proper financing.

"It took us two years, until March, 1926, to perform this preliminary work. We then organized the Sanitary Postage Service Corporation and brought in substantial capital. This enabled us to eliminate the outright sales of the sanitary postage machines and to adopt a policy of placing them free with the merchants, on a profit-sharing basis. The result was that where it took about eight years to sell 12,000 machines outright, it took us less than two years to place an additional 20,000 machines on a profit-sharing basis.

"What is still more important, we succeeded in placing the sanitary postage machines in such important locations as the United Cigar Stores; the Liggett Drug Stores; the Schulte Cigar Stores; the Owl Drug Stores, et cetera. Automatic postage service has thus become a national institution,

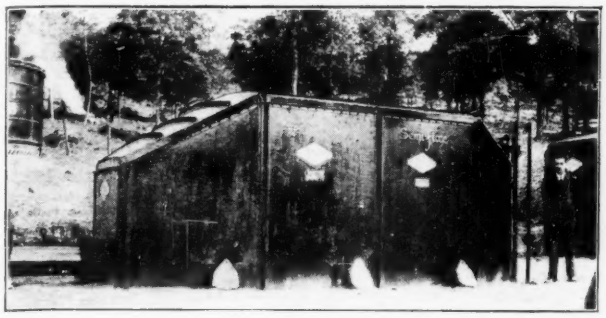
"TOGETHER with Mr. Granat and Mr. Schermack, and with the close participation of Mr. Nathan A. Smyth, Vice President and general counsel of our companies, we conceived a further step, and that is, the consolidation of the leading automatic enterprises in the field. It was then our good fortune to meet Mr. F. J. Lisman, of F. J. Lisman and Company, a banker who has been a member of the New York Stock Exchange for over 30 years and who, together with excellent maturity of judgment, preserves a wonderful, youthful attitude towards new ideas.

"With Mr. Lisman's help, we organized the Consolidated Automatic Merchandising Corporation, which is a combination of our three companies —the Sanitary Postage Service Corporation, the Schermack Corporation of America, and the Automatic Merchandising Corporation of America— together with the General Vending Corporation and the Remington Service Machines, Inc. F. J. Lisman and Company have underwritten the issue, and the Consolidated Automatic Merchandising Corp. has become a fact."



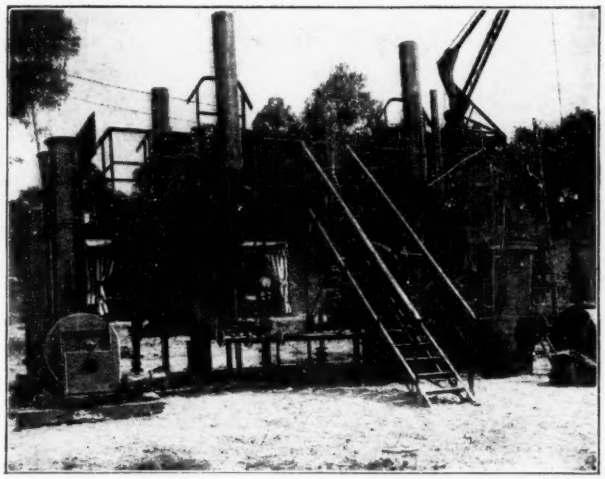
EACH STACK IS A UNIT

It may be taken out easily and quickly to get at the mechanism in the rear



THE "GAZOGENE" MANUFACTURING PLANT

Above is shown the Trihan kiln for burning wood to make charcoal and "gazogene." This type is important because it burns all sizes of wood whether in chunks, logs, or brush form. It is so constructed as to prevent leakage of the gas that is generated and also to prevent embers from flaming. The time of burning varies from 15 to 40 hours. The illustration at the right shows the plant for collecting the gases and condensing them into "gazogene"



"GAZOGENE" TANKS

The tanks in which is stored the cheap new motor fuel that is derived from wood

Wood Gases for Motors

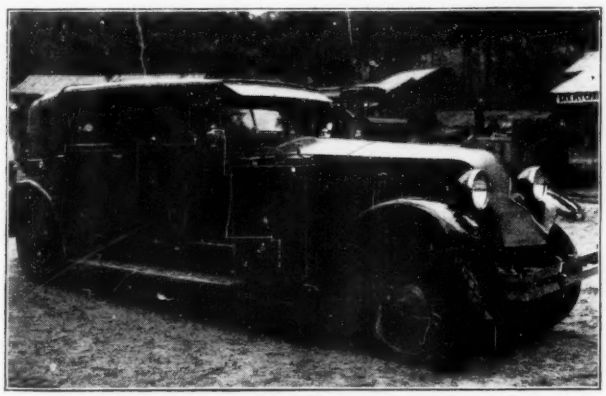
"Gazogene," France's New Gas, Promises to Replace Gasoline As Fuel

WHEN wood is carbonized to make charcoal, great volumes of gases are thrown off and usually wasted. The problem of utilizing these gases as fuel for gasoline motors has occupied the attention of French scientists for several years. Ever since the first efforts were made, in France, to substitute the "gas of the forests"—which is called "gazogene"—for gasoline in trucks and heavy motors, strenuous efforts have been made to adapt carburetors to the use of this unique fuel. The pioneer researches of M. Breton, a member of the Academy of Sciences of Paris, in connection with "gazogene," have thrilled France with the possibility of making its own motor fuel.

Now, according to reports, equipment for the manufacture of "gazogene" has been perfected and carburetors and motors have been adjusted to use it. At the recent Forestry Exposition near Versailles, "gazogene" manufacturing equipment and several types of vehicle motors using it were shown. Prominent among these were a luxurious touring car and a truck.

Details of the process of manufacturing "gazogene" are not very clear but it is understood that the gases given off from the charcoal kiln during the burning are collected, passed through water to be cooled and condensed, and are then placed in containers that are later to be mounted on the vehicle. It is simply a process of distillation of the resinous substance of woods.

The collection of the gases has presented such a problem that several types of kilns have been developed. One of the most successful of these is the Trihan, a photograph of which is shown at the top of this page. This consists of a rectangular tank-like oven which is easily separable and portable. In position, the seams are leak-proof and the base is tightly sealed with earth. The cover is removed, it is charged with wood which is ignited at one end, and the gases are drawn off through partitions of heavy cloth. The gases given off are then passed through the condenser mentioned above and the "gazogene" collected.

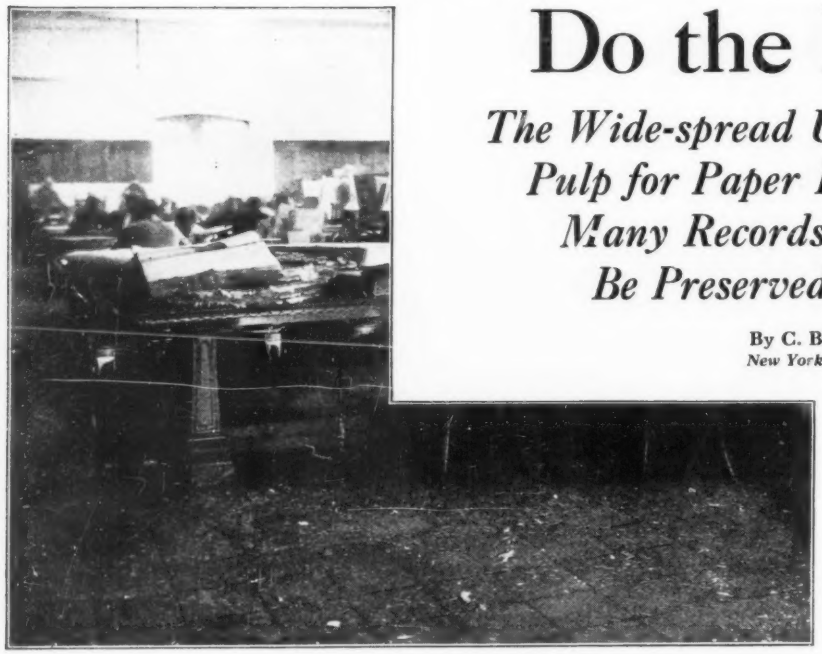


TOURING CAR WHICH RUNS ON GAZOGENE

A Renault car which has been adapted to the use of the new fuel. The "gazogene" is carried in the container on the side of the car

TRUCK ADAPTED TO THE USE OF GAZOGENE

A left-over American Army Liberty truck, with its container of "gazogene." The new fuel is said to be comparatively cheap



FRAGMENTS LITTER THE FLOOR

A part of the newspaper reading room of the New York Public Library is shown here. The floor has to be swept four times a day to remove the broken bits of deteriorated paper

Do the Records of

The Wide-spread Use of Groundwood Pulp for Paper Has Endangered Many Records Which Should Be Preserved for Posterity

By C. BINKLEY
New York University

THE 19th Century instructed us in what we call the scientific attitude toward history; it taught us the value of preserving records; it gave us to believe that an accurate understanding of all aspects of our past was essential to clear thinking upon the present. And having thus taught us the value and sanctity of all records, it began to print its records upon highly perishable wood-pulp paper.

No civilization since the invention of writing has entrusted its records to so fragile a medium as this wood-pulp paper. The bamboo strips upon which the sacred books of Ceylon are written, the clay tablets of Mesopotamia, the paper and silk of China, the papyrus of the old Mediterranean world, the parchment of medieval Europe—these materials had a life expectancy of centuries or millenia, whereas our ordinary newspaper print paper has a life expectancy of decades.

Egyptian papyri 2000 years old are in better shape today than some of the paper that went under the printing press during the World War. A manuscript from the time of Mohammed, written in Arabic on cotton-fiber paper, is still in a state of good preservation in the library at Leyden. The publications of the 15th Century look as if they may well last another 450 years; but many books and magazines printed in 1900 are rapidly disintegrating.

The art of making paper from silk, cotton, and linen fibers is about 2000 years old. The Arabs picked it up from the Chinese and introduced it into western Europe in Medieval times. Paper replaced expensive parchment in some of the manuscript book making of the 12th Century. The Emperor Frederick Barbarosa prohibited its use in deeds and charters, because he feared it was too perishable.

Then came the invention of printing. A great book industry grew up, revolutionizing European culture by making learning more accessible to the people. This book industry could not have developed from the invention of printing alone, because the great cost of parchment or vellum would have made books too expensive.

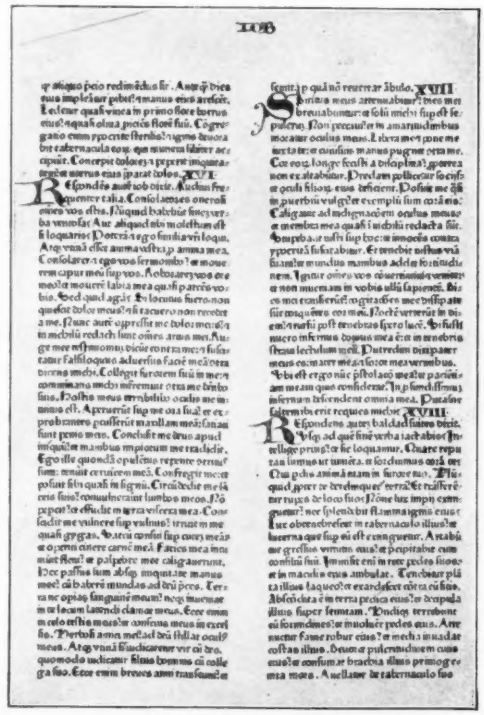
The paper-making industry was as essential to the new spread of learning as was printing itself.

AND the paper that was made in those centuries has stood the test of time. The Emperor Frederick's fears were unfounded. The paper charters have outlasted the legal rights founded upon them. And the books of the 15th Century are still with us.

In the third quarter of the 19th Century two discoveries of fundamental importance changed the basis of the paper industry. First was a machine for making paper on a continuous roll, which cut down the labor cost of paper making to a fraction of what it had been, and then cheaper substances came into use as raw material. Grass, straw, and wood were found to supply fibers which could be matted together as paper. The new paper was much cheaper than the old.

The chemical principles underlying the problem of paper deterioration are very simple. All paper is a felt made of fibers. If the fibers decay, the paper disintegrates. Some fibers are more likely to decay than others; they are, chemically speaking, more active. The most durable paper is one made of fibers which are most nearly inert. Papers are therefore to be valued in proportion to the chemical inertness of their fibers.

All of these fibers—cotton, linen, hemp, straw, grass, and wood—consist primarily of a substance known as cellulose. But wood cellulose contains constituent groups which are chemically active. Cotton, linen, and hemp are more inert. The disintegrating



PAPER FROM 1462

This is a photograph of a piece of rag paper, still as perfect as the day it was made, centuries ago

Science Face Ruin?

THE ancients left behind them records of great historical value to archeologists of the present day. Will we do the same for those who are to follow us? The ancients inscribed their writings on imperishable stone, vellum, parchment, and papyrus. We are printing ours on paper which, a few years hence will have disintegrated so as to be valueless to future historians.

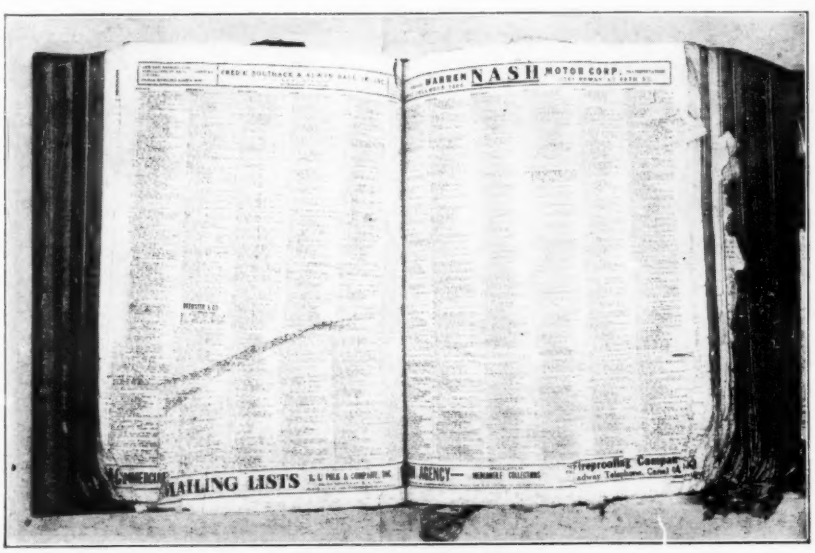
This state of affairs has been brought about by the great increase in the last two generations of the production of paper of a cheaper grade than was formerly available. What is to be done if we are to pass along to posterity the records of the knowledge of the present? In the accompanying article the entire situation is reviewed, and following it are the results of a survey by the SCIENTIFIC AMERICAN.—*The Editor.*

agency which operates most persistently upon wood-pulp paper is simply oxygen. That is to say, the decomposition of wood-pulp paper is chemically identical with the burning of a log in the fireplace, except that the process goes on at a lower temperature, and takes a longer time. In the presence of moisture or the fumes of gas, some papers may be attacked by acids left in them by the manufacturing process, or absorbed from the atmosphere. If the surface has been finished with gelatine, bacteria may sometimes attack damp paper. But the great enemy of paper is simple oxidation. Paper made from ground wood is powerless to resist this enemy. Paper made from rags of cotton, linen, or hemp will resist it.

THERE is danger that our interest in this matter may lie dormant until it is too late. But if we are to attack the problem while there is time to solve it adequately, the course to take is fairly obvious.

On the one hand we have to consider the printing that is being done today. Most of the copies of a newspaper, have fulfilled their purpose when they have been read. There is no sense in having them printed on any better paper than is now used. But a few copies of every publication—even of newspapers—should be printed upon paper that will last. Some publishers of books, and a few magazines publishers, bring out a special rag-paper edition. The New York *Times* took the lead among newspapers in this matter. This tendency must be systematized. If it is not possible to put rag-paper copies of a publication on sale, at least a few such copies should be made for office filing or copyright registration.

And then what are we to do with the fifty years legacy of decaying paper that now lies in our libraries? Here there are two general types of solution, both of which lie within the competence of modern chemistry to perfect and apply. On the one hand, an attempt can be made to preserve the existing paper stock by some treatment; on the other hand, a means can be found for copying the material which is on the printed pages, after which the existing volumes could be discarded.



ONLY TWO YEARS OLD

The raggedness of this two-year old copy of the New York City telephone directory is not entirely due to use. The paper has decomposed to such an exent that it breaks off

NEWSPAPER FILE

Bound volumes of back issues, showing the ravages of time on newsprint paper

Certain library methods are already in use which accomplish one or the other of these ends. The New York Public Library and the Hoover War Library have preserved certain important papers by pasting a sheet of Japanese paper over every page. This is an expensive process, and we do not know how effective it is, because it has not been long on trial. Another method of preserving paper stocks is the cellulose acetate spray, which permeates the paper stock and strengthens it by adding to its body. This method also has yet to stand the test of time.

IF we give up hope of saving the paper stock, we can copy off the reading matter upon stronger paper by the photostat method. The cost of materials precludes the large-scale use of this method. The suggestion is therefore made that photographic copying should be done on a reduced scale, to be read back again with a magnifying glass or by projection on a screen. It is chemically and optically possible to accomplish reductions of twenty or thirty diameters, which reduces the cost of photographic copies to less than the original purchase price, (except in the case of newspapers). The danger remains that the photographic film may itself prove perishable. Possibly photography upon metal plates may accomplish the desired result.

These possibilities must be explored. The whole problem must be systematically investigated. This skeleton must not remain indefinitely in the closet of modern scholarship.

The Scientific American Survey of the Problem

WHILE Mr. Binkley's survey is most interesting, it will be of more value if supported by further definite facts. We have gone into the subject

SPANISH-AMERICAN WAR NEWS

Note how this 30-year old newspaper has deteriorated until its strength is gone

with the idea of presenting all sides. We have called upon the Forest Products Laboratory, the Bureau of Standards, and the Library of Congress.

The Forest Products Laboratory say that they have not investigated the subject but they have this to say:

"We note the use of the term 'wood-pulp' paper in Prof. Binkley's manuscript. While this is technically correct, it is misleading in that papers containing mechanically ground pulps are undoubtedly what are meant. Groundwood pulps and chemical wood-pulps have altogether different properties and the latter are perhaps about as permanent, if properly tested, as papers made from rag fiber. It is suggested that a distinction be drawn and that the term 'groundwood papers' be used in preference to wood-pulp papers, when the former is used.

"There is no question, of course, about the rapid deterioration of papers containing large proportions of groundwood pulps. However, there may be an undue prejudice against papers made from the purer forms of chemical pulps in favor of the rag fiber products."

THE Bureau of Standards reports: "While we have made some studies of the permanence of paper, we do not have at present enough information to make a definite statement concerning the relative durability of the various fibers used at the present time for making paper. We have recently initiated further research on this subject which we hope will lead to quite definite information.

"We are sending our present views and other information. (*Too long to re-print—Ed.*) You will note that where the greatest degree of permanence is required we recommend the use of the highest grade rag-fiber paper carefully prepared so as to contain minimum amounts of deteriorating agents. From theoretical considerations it would seem that such paper would necessarily have greater permanence than the best wood-fiber papers. At the present time, we agree with the opinion held by most investigators that the most durable paper fibers are those prepared from materials consisting of the purest forms of cellulose. As new white cotton and linen rags are a very pure form of cellulose, only slight chemical action is required to complete the purification of them. On the contrary, wood cellulose requires a very severe chemical treatment for its isolation and it seems reasonable to suppose that even if the cellulose obtained is quite thoroughly purified, the drastic purification process materially weakens the cell walls of the fiber elements so that they are in a more sensitive condition as regards mechanical stresses and possibly deteriorating agents than the rag fiber.

"IT is no doubt true that there are many grades of rag-fiber papers that are not more durable than wood-fiber papers. When the lower grades of rags are used, the chemical treatment required is fairly severe and no doubt the fiber elements are weakened as in the case of wood fibers. We believe that some of the present high grade wood fibers, especially those of considerable purity, such as the so-called alpha fibers, have considerable permanence, but it remains to be proven that they approach high grade rag fibers in permanency."

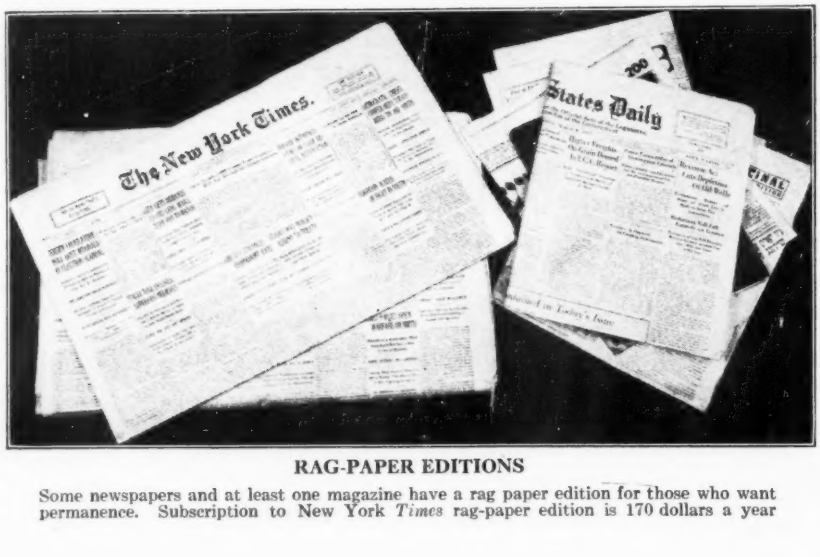
The Library of Congress is vitally interested in this subject and the officials sound a new note which deals with housing rather than manufacture. The Acting Librarian says:

"In approaching this problem you have probably given very careful consideration to the conditions surrounding the storage of the material in the book-stacks or other rooms, that is, ventilation, percentage of moisture in the air admitted, degree of temperature of air, screening of air of impurities before admission, et cetera, et cetera, (and the air of certain localities is heavily laden with gas fumes, et cetera). In storing our publications, we have always stressed these points as of the utmost importance, and as scientifically worked out, in relation to our material, they have contributed much to the preservation of our publications."

DR. TH. BENTZEN, a well-known paper chemist of long experience, says in "Technical Association Papers" of the Technical Association of the Pulp and Paper Industry: "The whole question in this paper is the rags. The question is, is it possible to make absolutely permanent paper, or a paper as permanent as you can make it out of rags, if you use sulfite pulp? We must remember that when we are talking about rags it means first-class, new, good rags. Compare with that the first-class sulfite pulp.

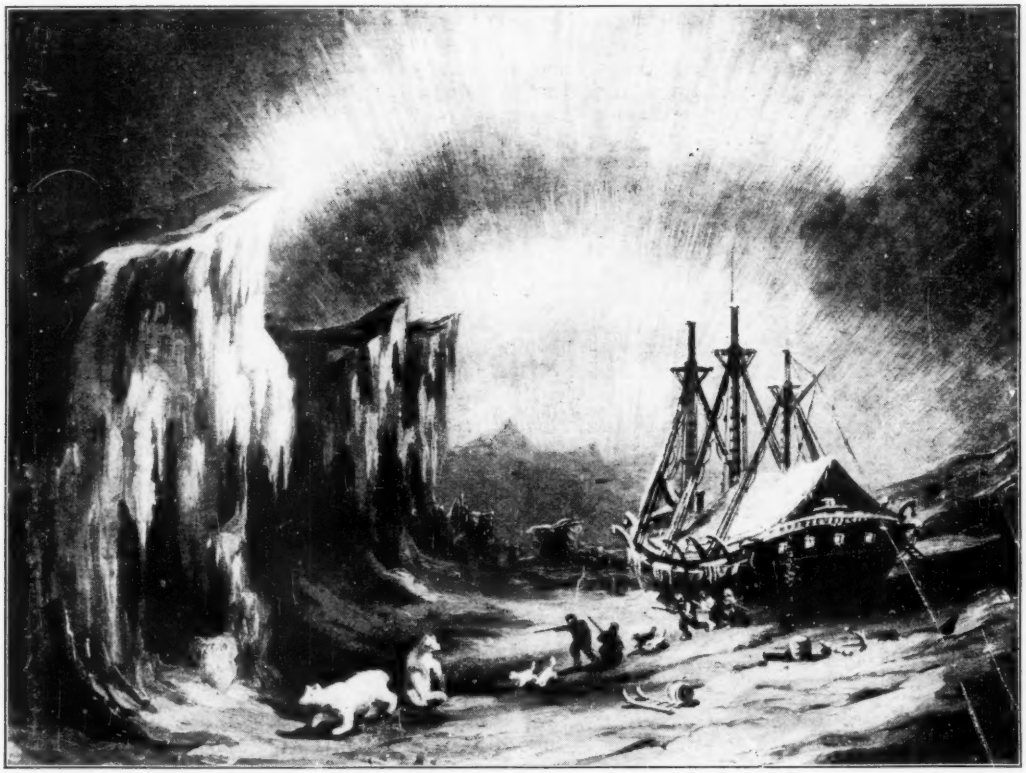
"Some people say if we make sulfite pulp as good as possible and wash it out, it is as good as old rags. That may be, but is it as good as new rags? That is the question. It would be, of course, a high-priced paper if we should make a paper the way we made it in the old days, but for certain uses to which that paper is to be put, for documents and records to be put in libraries to stand for centuries, there is no other way, as far as I can see, than to go back to the old way—wash the stuff out and use the very best."

Only about 2½ percent of the paper made in the United States is rag paper. We have not had chemical pulp paper long enough to pass an authoritative opinion; 60 years is a small part of the life of a printed book. All books and periodicals of more than ephemeral value should have at least library copies put on rag paper or on a very high grade chemical pulp paper. The problem is one of great gravity.



RAG-PAPER EDITIONS

Some newspapers and at least one magazine have a rag paper edition for those who want permanence. Subscription to New York *Times* rag-paper edition is 170 dollars a year



THE AURORA BOREALIS—FROM AN OLD PAINTING

It is only recently that scientists have made appreciable headway in solving the interesting problems connected with the aurora. There is little reason to doubt that it is caused by electrons shot out into space from sunspots, although not all sunspots cause auroras. Much yet remains to be learned

The Mystery of the Green Line

The Aurora Borealis Has Long Provided Science With One of Its Most Difficult Puzzles. This Problem is Now Giving Way Before Intensive Research

By J. C. McLENNAN, Ph.D., D.Sc.
Director of the Physical Laboratory at the University of Toronto
Fellow of the Royal Society

THE beauty of the aurora borealis when it is seen in its full glory in the far north has always impressed those who have witnessed the display, and it has excited many to search for the true nature and cause of the phenomenon. However, for a long time it remained one of the mysteries of nature, and it is only within recent years that scientists have commenced to understand what the aurora is and how it arises. The problem is not yet entirely solved. The following paragraphs present some established facts, and some of the most reasonable suggestions.

Figure 1 shows a pair of photographs of the aurora taken at the same instant from two observatories in Norway some miles apart. They show the most usual form of the auroral display as it is seen in Europe or America—a curtain of streamers, usually greenish white in color. This is the appearance which is familiar to most people, since it is only in the thinly populated regions of the far north that the full display appears, when at times the sky is filled with green and pink drapery.

THIS form of the phenomenon, which might be considered as the aurora proper, occurs at irregular intervals, and evidently only when some special condition exists. However, it has recently been discovered that, on any clear night, in any latitude, the whole sky is glowing with a faint green light which we now know to be allied to the aurora, and which must therefore be considered at the same time.

The slightly different shapes of the two views of the display in Figure 1, and their different positions against the background of the stars are shown clearly. By taking two simultaneous photographs like these from different places, the height and true direction of the streamers can be calculated. A great number of such pairs of photographs have been taken of auroral displays, especially in Norway, by Professor Stormer, and the actual places from which the light is coming have been determined. In this way it has been learned that the region in which the aurora takes place is from 50 to 500 miles and more above the surface of the earth, with its greatest frequency and brilliance at a height of about 60 miles. At this height there are about one hundred million million molecules of gas per cubic centimeter, which is about one one-hundred-thousandth of the density of the air at

the surface of the earth, and about one one-hundredth of the density in an ordinary gas discharge tube.

By actual human experience we know the conditions of the atmosphere only to a height of nearly eight miles above the earth's surface, the greatest height ever reached by an airplane. By means of small balloons carrying self-recording instruments the exploration has been extended to a height of about 14 miles. As to the conditions existing above this height, there is no direct information. We know for instance that the temperature of the air falls as we go up until at a height of seven or eight miles it is about 70 to 80 degrees, Fahrenheit, below zero. Then a layer is reached in which the temperature remains constant as high as records have been secured. What happens above the 14-mile level? Does the temperature remain at 80 degrees below zero to the top of the atmosphere? Or is there another change? Now that scientists are beginning to understand the processes involved in the production of the aurora, a study of this phenomenon will give us the best means of determining conditions in the upper atmosphere at heights to which no balloon can ever hope to penetrate.

IN the general study of the frequency and distribution of the auroral displays it was very soon noticed that the occurrence of the phenomenon is frequently accompanied by a "magnetic storm." The magnetic field of the earth is disturbed, as is shown by the behavior of the compass, and stray magnetic effects in the atmosphere give rise to static on the radio, and sometimes even effect land telegraphy by causing stray induced currents in the wires. This suggests that there is actually an electric current involved in the streamer form of the aurora, and it is now believed that these streamers of luminosity are due to streams of electrons which cause the upper atmosphere to glow just as a discharge tube glows when a current of electricity passes through it. Professor Birkeland has calculated the paths which would be followed by such streams of electrons as they come under the influence of the earth's magnetic field, and has shown that they would follow very closely the course of the streamers of an auroral display.

For the most probable source of these electrons we find we must look to the Sun. There is a very definite distribution of auroral displays in time as well as in space. The number of displays per year varies from year to year in such a way that about every eleventh year there is a maximum of auroral activity. It is known that the number of spots on the Sun also varies from year to year with a maximum every 11 years. A long series of observations of sunspots and aurorae has shown that this is not mere coincidence, and that the maxima occur at the same time. There must therefore be some connection between the aurora and the kind of activity which produces the sunspots and prominences on the Sun. It has been suggested, and probably correctly, that the Sun gives off streams of electrons at such a time of activity, and that some of these electron streams strike the earth's atmosphere and excite the molecules there to emit the light of the aurora. Such electrons would all be stopped in the upper layers of the atmosphere, and so the aurora does not appear below the 50-mile level.

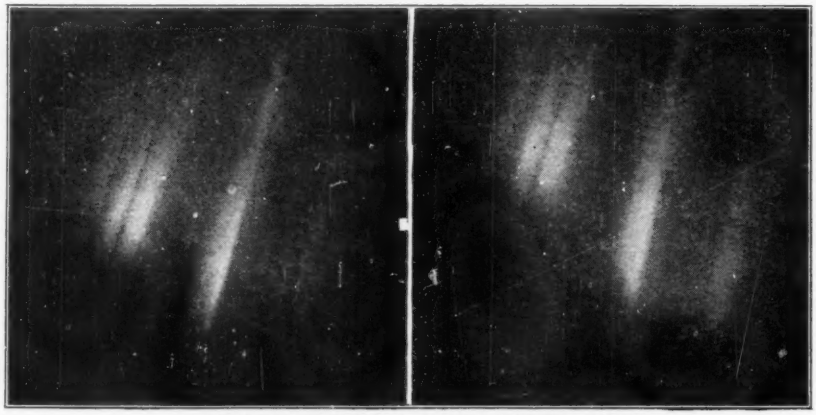
THE ever-present green light of the night sky may possibly be due to the same cause or to electrons from a source other than our Sun, but it is more likely in this case that the atoms are excited to emit the light by ultraviolet radiation of short wavelength which must be emitted by the Sun, but which cannot penetrate the denser lower layers of the atmosphere.

Just as the best, and almost the only, way of learning anything about the constitution of the stars is by analysing the light they give out, by means of a spectrograph, so, in the case of the aurora, the best way of using it to study conditions in the upper atmosphere is to study the spectrum of the light it emits. Figure 2, at bottom, is a reproduction of the spectrum of the auroral streamers; in Figure 3 is the spectrum of the light from the sky on a clear, moonless night (with the spectrum of iron for comparison purposes). The spectrum of the auroral streamers consists of a number of bright bands shaded towards the violet end of the spectrum, and one sharp strong line in the green at wavelength 5577A, the so-called "auroral green line." The spectrum of the clear night sky shows only the one line at 5577A.

Figure 2, at top, is the spectrum of nitrogen gas in a discharge tube, showing the "negative bands," 3914, 4278, 4708A, which are clearly the same as the bands in the spectrum of the streamers. Another group of bands, the "positive bands" of the nitrogen spectrum, have also been found in the spectrum of the aurora, but very faintly as compared with those shown in the reproduction. This shows that nitrogen must be a prominent ingredient in the region where the auroral light originates, and as there must be nitrogen in the upper atmosphere, we have further evidence for supposing that the aurora is a form of gas discharge in the region above the 50-mile level of the earth's atmosphere.

THE line at wavelength 5577A, which is such a prominent feature of the spectrum of the aurora, was a complete mystery for a long time. Nobody succeeded in reproducing it in the laboratory, and so no one could say to what element it belonged, until in 1925 its origin was shown by the writer, in collaboration with Dr. Shrum at the University of Toronto, to be traceable to gaseous oxygen. This remarkable line in the spectrum of oxygen shows great variations in intensity when the conditions under which it is excited are varied. Helium or neon when mixed with the oxygen enhances the line, and argon does the same thing to a very much greater extent. The spectrum obtained with a mixture of oxygen and helium is shown in Figure 3. The line of wavelength 5577A, it will be seen, is brought out very distinctly, accompanied, however, by lines due to helium, and by other lines of the ordinary spectrum of oxygen. Very careful measurements of the wavelength have shown beyond any possible doubt that this oxygen green line is the same one as appears in spectra of the aurora and of light of the night sky.

It appears, therefore, that the spectrum of the aurora can be accounted



A SIMPLE PROBLEM IN TRIANGULATION

Figure 1: The same aurora, photographed at the same instant from two separate stations, will show against an altered background of stars. From these data, the elevation is calculated

for by the presence of nitrogen and oxygen in the region where it originates. However, only certain parts of the ordinary spectra of these gases appear in the spectrum of the aurora. In the case of oxygen especially, why is it that we find only one spectral line, and that line one that appears only faintly in the spectrum of oxygen electrically excited in a discharge tube? A consideration of this question in the light of our present knowledge of the origin of spectra in general, supplemented by experiments now in progress in Toronto and elsewhere, will eventually shed much light on the conditions in the upper atmosphere.

We know that by gradually increasing the amount of energy which is supplied to the atoms or molecules of a gas, they can be made to emit more and more of their spectra. The amount of energy which is required to excite any particular portion of the spectrum is usually expressed by means of the "excitation potential," which is the number of volts that will make an electron travel with sufficient kinetic energy so that when it strikes the molecule the light required is emitted.

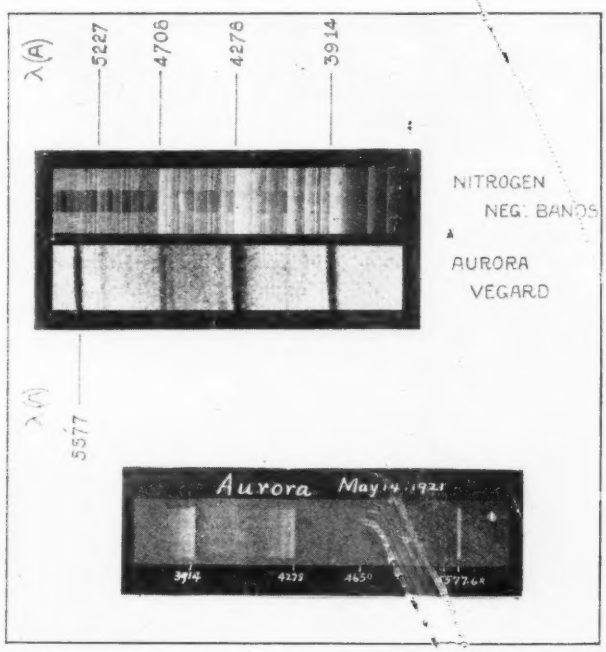
The "negative bands" of nitrogen, which appear so prominently in the spectrum of the auroral streamers, are due to ionized nitrogen molecules, that is, to molecules which have lost one electron, and their "excitation potential" is about 20 volts. The "positive bands" are due to normal nitrogen molecules and can be excited by more slowly moving electrons. These "positive bands" appear, although faintly, in the auroral spectrum, but the line spectrum of the nitrogen atom, which requires considerably more than 20 volts, does not. The streamers of the aurora, therefore, are apparently due to electrons which are sent out from the Sun and strike the upper atmosphere with an effective velocity corresponding to a little more than 20 volts. They appear to be sent out in more or less concentrated streams at irregular periods of special solar activity.

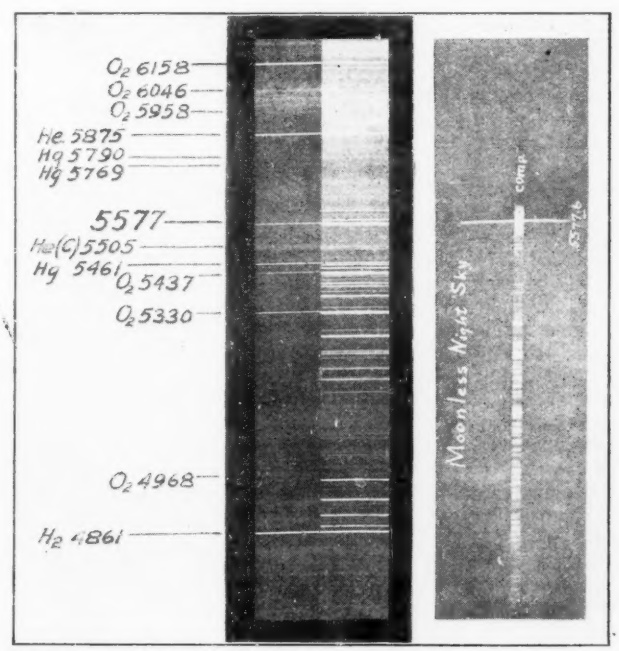
ON the other hand, the radiation of wavelength 5577A which comes to us from the night sky and appears to be emitted at all times and in all localities, must obviously be due to some other agency, and to something with less energy than the 20 volts required to produce the "negative bands" of nitrogen. Even the lower voltage required to produce the positive bands of nitrogen fixes an upper limit to the amount of energy required. The exact place of the spectral line 5577A in the scheme of the oxygen spectrum was definitely determined only very recently. Since it is a sharp line it must be due to the dissociated oxygen atom, and not to the molecule. It is known that oxygen readily dissociates into atoms by ultra-violet light of wavelength approximately 1750A and also that solar radiation of wavelength 2070A when absorbed by oxygen transforms the latter into ozone. Finally solar radiation of wavelength about 3000A, on being absorbed by ozone, re-transforms the latter back into oxygen. With such processes going on it is clear that in solar radiation we have an agency capable of furnishing an ample supply of oxygen atoms in the upper atmosphere.

Moreover, recent investigations have shown that atoms of oxygen can exist in any one of three states, of which one is stable and two are metastable. Energy relations that apply to the matter indicate that the atoms of oxygen are in one of these metastable states when they emit the light of the auroral green line, that heretofore mysterious part of the aurora's spectrum.

The state of the oxygen atoms immediately after their emission of this light has also been quite definitely ascertained. The investigations just completed on the magnetic resolution of the green line furnish the information that clears up this point and a few others that were somewhat obscure. We know now, beyond conjecture, how it comes about that oxygen in the upper atmosphere can be made to send out the light of the auroral green line that reaches us continuously from the night sky.

Spectrum analysis has recently enabled us to clear up the mystery that has long existed in men's minds regarding the origin of the light sent out by nebulae. We have learned that this light originates in highly ionized atoms of oxygen and nitrogen in metastable states. The puzzle as to the origin of the famous "green line" radiation, the most important and characteristic feature of auroral spectra, has also been solved. The auroral green light is emitted when oxygen atoms pass from one of their metastable states to the other.





SPECTRUM OF THE AURORAL STREAMERS

Figure 2, top: Spectrum of nitrogen gas in a discharge tube, showing the negative bands. *Bottom:* Spectrum of the auroral streamers

Figure 3, left: Spectrum obtained with a mixture of oxygen and helium; note line 5577. *Right:* Aurora spectrum on a moonless night

The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.
Editor of the Journal of the American Medical Association *and of* Hygeia

Artificially Ripened Celery

ETHYLENE gas is used in industry to hasten the ripening of fruits and vegetables. It is one of the most popular anesthetics used in American surgery, replacing to a considerable extent the use of ether, chloroform, and nitrous oxide. Some investigators have been concerned as to whether or not the rapid ripening of fruits and vegetables by this means would not interfere seriously with their content of vitamins.

Dr. M. F. Babb, working in the University of Maine, undertook experiments with ethylene in the ripening of celery. He tested the celery ripened by ethylene as compared with celery ripened in the natural manner. Young rats of the same litter which weighed about the same amount were put on a diet free from vitamin B. Under such a diet the animals develop symptoms which are definite evidence of vitamin B starvation. These animals were then fed with ethylene ripened celery and with that ripened in the natural manner. The results indicated that artificial ripening with the gas is not injurious to the vitamin B content of the celery.

The results with celery cannot be taken as a generalization to be applied to the effects of ethylene on all other fruits and vegetables. Tomatoes are also being artificially ripened by ethylene, and oranges are being given a rapid coloration by exposure to this gas. It will be worth while to discover whether the ethylene ripened tomatoes can compare with sun ripened tomatoes in vitamin content, and whether or not the oranges are injured in any way by the artificial method.

Bakelite in Industry

EACH time a new product is brought into industry as, for example, Duco paint or Bakelite, or ethyl gasoline, questions at once arise as to the possible dangers to human health from the use or handling of the new substance. Bakelite is a synthetic resin or condensation product formed by the combination of phenol and formaldehyde. Each of these substances is in itself highly irritating to the human skin. Phenol gangrene is a common condition and has frequently resulted from the use of even household products containing phenol compounds. Formaldehyde is an irritant substance which may produce severe redness and inflammations of the skin. Knowing these facts, the manufacture of Bakelite is carried out in an enclosed apparatus. Through carelessness, however, it is quite possible for the substance concerned to come in contact with the skin of workmen and to produce severe irritations.

In the second phase of Bakelite manufacture, the resin made in the enclosed process is manipulated as a dry powder or as a liquid resembling varnish. In this work industrial alcohol or benzene may be employed. Deaths from benzine poisoning are already recorded. Moreover, numerous cases have occurred of irritation of the skin from benzine, which acts as an irritant by dissolving the fat from the skin and thus making it hard and brittle.

When Bakelite powders are made up into hard objects, the phenol-formaldehyde resin powder is diluted with a filler, used to an extent of 10 percent. This filler is usually a drug known as hexamethylenetetramine, used in medicine in infections of the bladder. It is a skin irritant, and in the presence of heat and perspiration may bring about irritations of the skin of workers with Bakelite.

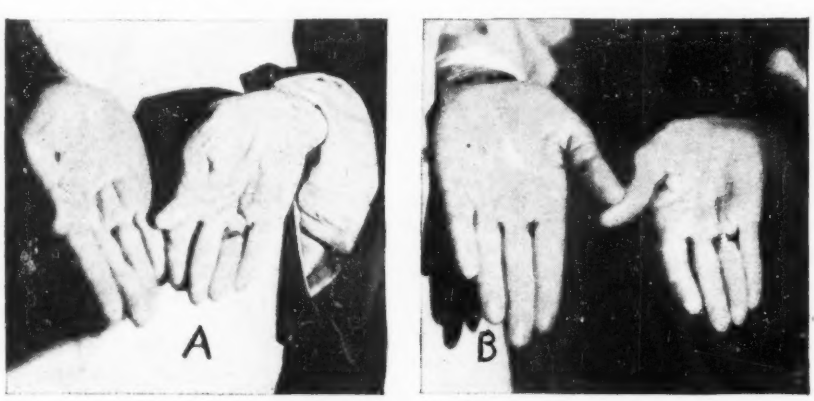
The brief consideration that has been given to this problem is significant of the thought that must be given nowadays to every new process in industry. The human being is sensitive to many foreign chemical substances and modern scientific industrial medicine has as its main task the prevention of industrial diseases in workers with dangerous products.

Duke's Palm Color Test

ONE of the important factors for determination in relationship to the changes occurring in health and disease is the state of the blood both as to the number of the red blood-cells and the amount of red blood coloring matter in the cells. There are many scientific methods for determining exactly how many red blood-cells there are and exactly how much red blood coloring matter may be present.

All of these methods involve the use of considerable apparatus and delicate manipulation by trained technicians. Dr. W. W. Duke believes, however, that slight or marked grades of anemia, which is an insufficient amount of these important substances, or of plethora which has to do with excessive quantities, can be determined readily in many cases by comparing the color of the palm of the hand of the person concerned with that of a person known to be normal.

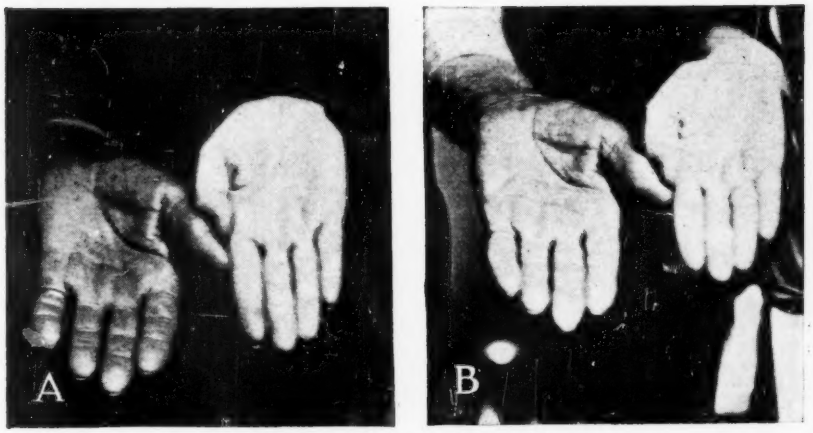
He finds that the color of the palm is remarkably constant—much more so, in fact, than the color of other surfaces of the body, probably because it takes a smaller part in regulating the loss of body heat. It may



DUKE PALM COLOR TEST

A shows the palm of a woman with pernicious anemia (on the right); her weight was 85 pounds. The red blood-cell count was 1,180,000; the hemoglobin, taken in sunlight, 50 percent. *B* shows her palm after the introduction of 1200 cubic centimeters of blood; the red blood-cell count was 3,370,000; the hemoglobin, 80 percent. Note that in spite of persistent low red blood-cell count, the color of palm was restored to very nearly normal

be desirable sometimes to know promptly whether or not blood changes have occurred—for example, immediately after a blood transfusion has been given. Doctor Duke submits pictures revealing the changing color of the palm under various circumstances.



ANOTHER PALM COLOR TEST

In *A*, the palm on the left is that of a patient with true polycythemia and a red blood-cell count of nearly 8,000,000. In *B*, note the paling of the palm following the withdrawal of 2000 cubic centimeters of blood in divided doses. The red blood-cell count was eventually reduced to nearly normal, with marked improvement in the general health of the patient observed

Danger of Lead Poisoning from Indelible Pencils

IN several instances in which portions of indelible pencils have been forced into the human body through accident or otherwise, serious symptoms have resulted. In one case, splinters of the pencil were forced into the hand of a worker. Five weeks later he had severe intestinal troubles with jaundice, and three and one half months later swelling of the hand with pain and disturbance of the kidneys. An operation for the removal of the indelible material resulted in eventual recovery.

When portions of the indelible pencil get into the eye, there may be severe inflammation with secondary infection, and sometimes even destruction of the eye. For this reason, it is absolutely important to avoid getting fragments of the indelible pencil into the eye while it is being sharpened.

The lead of indelible pencils in common use at this time is composed of graphite, kaolin, and some aniline dye stuff with methyl violet. Linseed or cottonseed oil may be used as a binder.

The makers of indelible pencils are exposed to a variety of hazards associated with the contact of the chemical components with the human skin. In addition to the aniline dyes, there are acrolein, formed on the heating of oils in the baking process, the glue, and the paint.

Industrial Skin Diseases

IN 1700 Ramazzini, referred to as the "father of industrial hygiene," made the first real contribution to a study of the diseases of the skin associated with occupations. He described the type of inflammation that occurs in washerwomen, bakers, farmers, and practitioners of many other trades. Dr. Harry R. Foerster has recently summed up our knowledge of industrial skin diseases. These result not only from such physical causes as heat, light, and rubbing, but also from pressure and compression, from cold, from irritating chemicals, from oils, and from many other substances.

Irritation or breaking of the skin gives opportunity for germs to get under the skin and to break down the tissues. Already many states have passed laws protecting the worker in industry who becomes infected as a result of the industry. The specialists who are anxious to prevent these diseases urge frequent cleansing with soap and water, frequent changes of dust-laden, and oil-soaked clothing, the use of grease on the hands and arms during work with dangerous chemicals, the abolition of dangerous paint solvents, and the provision of personal towels and cleansing rags instead of roller towels and the exchange of personal towels.

Persons with specially sensitive skins or those subject to skin diseases should be controlled when engaged in general industry. The moment a worker develops a skin disease he should be taken from the work until the condition has been properly diagnosed and safely controlled. Several famous hospitals and institutions have already established special clinics for the study of industrial skin diseases.

Irradiated Ergosterol

AS soon as it became definitely established that rickets can be prevented by exposure to ultra-violet rays or by the use of cod-liver oil, the chemists began to search for the constituent in the cod-liver oil which was responsible for the same effect as the ultra-violet rays. It has been definitely established through the experiments of Windaus and Hess, and of Rosenheim and Webster, that a substance known as ergosterol, associated in the human body with cholesterol, is activated by the sunlight to produce vitamin D, and that it is the vitamin D which is the important substance in the prevention of rickets. It has been shown by Hess and by Steenbock that various foods, such as oils, milks, and cereals can also be given specific anti-rickets properties merely by subjecting them to the ultra-violet rays of the sun or those obtained from some artificial source.

Ergosterol which has been submitted to ultra-violet rays is apparently the most highly potent substance against rickets that has thus far been developed. It is one hundred thousand times as powerful as cod-liver oil and is able to prevent or cure rickets in rats in a daily dose of one twenty-millionths of a gram. Since the announcement of these discoveries, preparations of irradiated ergosterol have been prepared and are being offered commercially to the public in many places.

Experiments with the substance in the prevention of rickets have been undertaken by Hess and his colleagues. As a result of the administration of this substance, the calcium in the blood is increased greatly, apparently without severe harm to the infants to whom the product was given. The phosphorus content of the blood is also increased. Foreign investigators in an attempt to determine what might be the dangerous dose, gave tremendous amounts of the irradiated ergosterol to rats and found that an amount equivalent to ten thousand times the minimum curative dose might cause calcification of some of the tissue of the body.

In two cases in infants, symptoms considered not especially desirable developed with high percentages of calcium. Indeed, the physicians are of the opinion that these symptoms are similar to those that follow an overdosage of ultra-violet rays, either from the sun or from some artificial source.

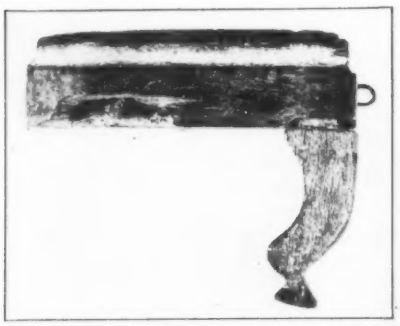
At present, most of the preparations of irradiated ergosterol on the market have not been officially standardized. Indeed, ergosterol itself has not been standardized, so that the substance must be used with great care. Hess believes that regular tests of the calcium and phosphorus content of the blood should be made during the giving of the product as the one certain method of assuring normal rather than overaction of the beneficial ergosterol.

➤ CLEARING AN OLD QUARRY

This view is typical of Egyptian archeological work. The chief objective was to salvage the statues from the adjoining temple which the ancient wrecking gangs had destroyed. Some fragments weighing a ton or more were recovered. Many of the statues were covered over so soon after they were carved that the elements had no effect on them and the colors of the paint were as brilliant as when first applied to certain places

➤ RE-ASSEMBLED GRANITE SPHINX

Several large granite sphinxes were found, probably from the temple courts. Here is one which has been assembled. They show how the Egyptian prized his hard stones and left their polished surfaces to be admired for their own sakes, picking out in paint only the details which need emphasizing, such as the headdress, the eyes, and the jewelry. The sphinx will take a worthy place in a museum after "repairs"

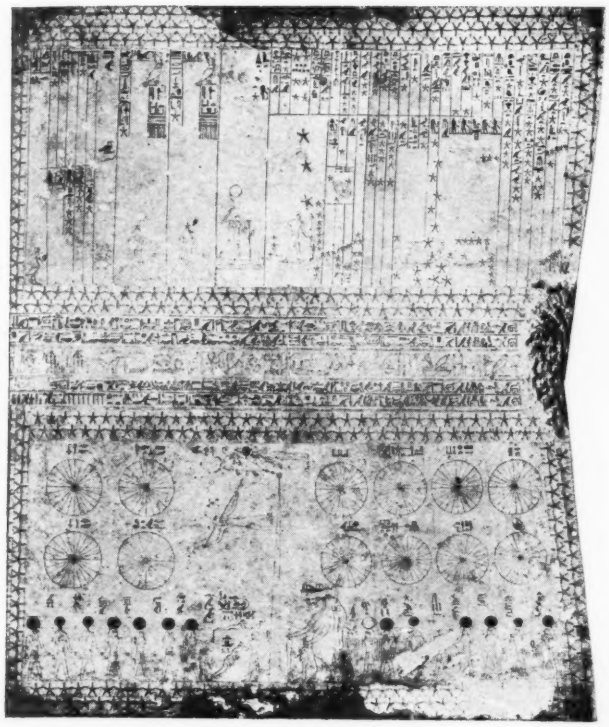


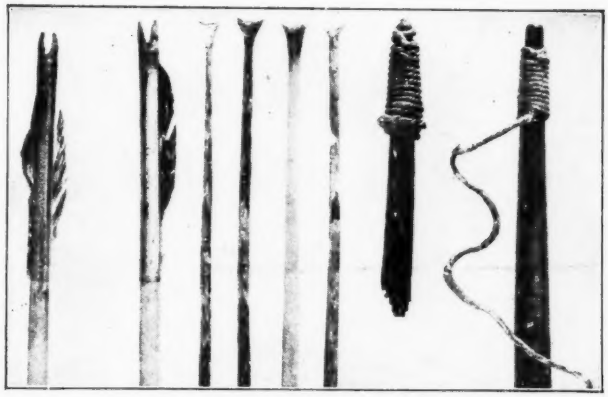
➤ EGYPTIAN GAME BOARD

With this game board we get an echo of one of the game crazes. It is the story of mah-jong 4000 years ago. This board is so worn that a patch had to be inserted to replace enlarged holes

➤ AN ARCHITECT STAKES A CLAIM

The "Superintendent of all the Royal Works," Senmut, the architect and engineer, had an aquiline nose, his face was expressive and wrinkled. Much of his life has been restored to us by the marvelous science of archeology. In this illustration, which shows the western end of the quarry, we find the brickwork at the entrance to Senmut's tomb at the lower left-hand corner. His intention was to have a perfectly conventional tomb and then a secret burial crypt under the temple. Our modern municipal contractors could take a lesson from this wily old engineer



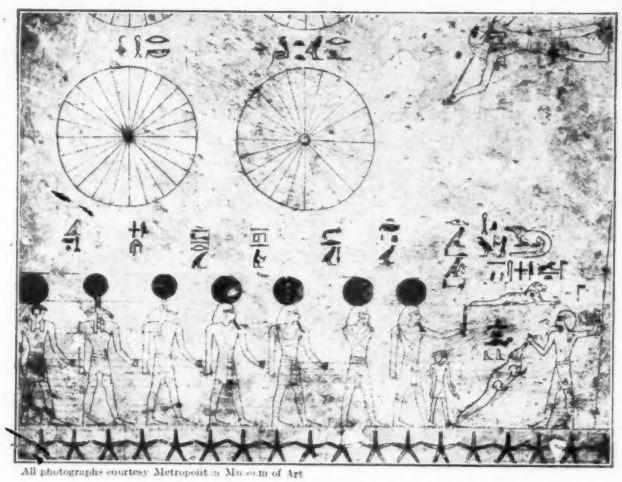


THEBAN BOWS AND ARROWS

Chisel edges of flint were set in cement in an ebony tip, while the shaft was of reed with three feathers. They were extremely deadly. The nobles had enough bows and arrows in the crypts of their individual tombs to equip a bodyguard of their retainers

AN ASTRONOMICAL CEILING

The gem of the decorated chamber in the tomb of Senmut is its ceiling. Here we have the heavens mapped out above us in one of the best and one of the earliest astronomical charts yet found, as drawn by an artistic penman or rather, brushman, of 1450 B. C.



TERRA COTTA CONE FRIEZE

These cones probably represent the ends of the poles or logs of the roof of an ancient Egyptian house. Terra cotta cones a foot long are found on the Theban necropolis. Cones are 34 centuries old

CELESTIAL BODIES DEPICTED

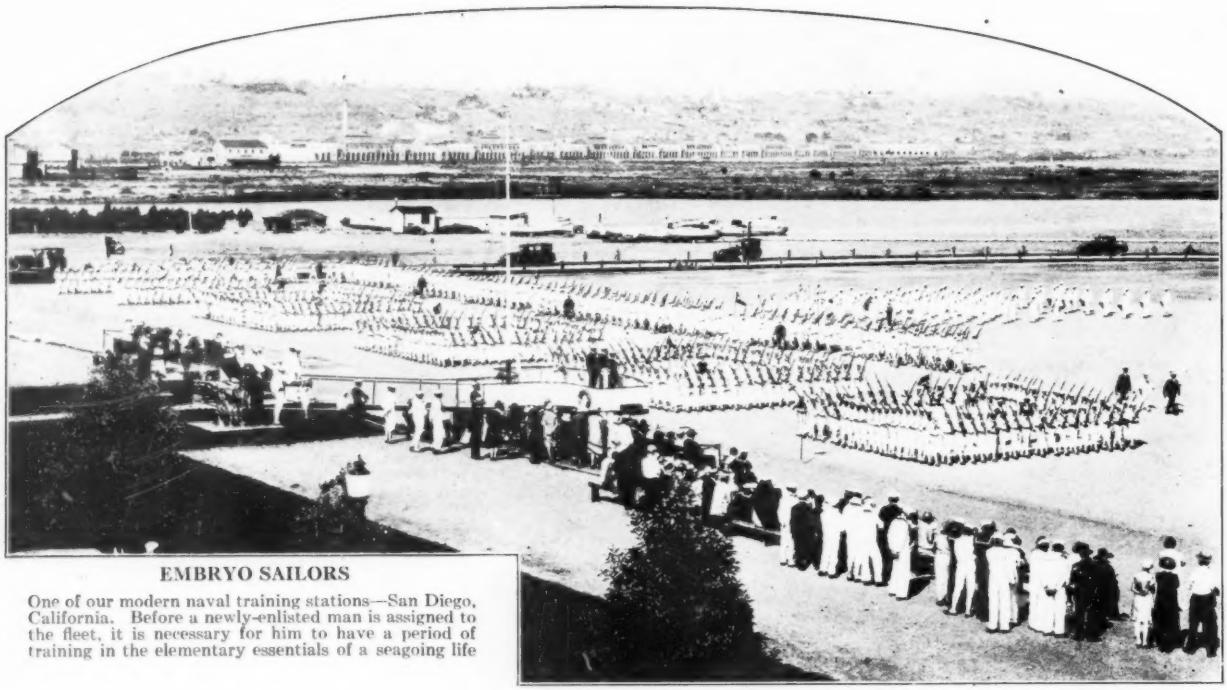
An enlarged view of the lower part of the upper picture. Across the sky are ancient monthly festivals each as a circle with its round of 24 hours and, below pass the constellations of the northern sky

All photographs courtesy Metropolitan Museum of Art

Adventurous Archeology

ONE of the best cross-sections of old Egyptian life which has ever been published will be found in the account of the Metropolitan Museum of Art's excavation at Thebes, 1925–1927, written by Mr. Herbert E. Winlock of the Egyptian Department. We only have space for one of the many stories in the interesting 75-page pamphlet. As our readers know, the Museum's archeologists have been carrying on excavations at Thebes for many years. The work is practically finished on the Temple of Mentuhotep and on the cemetery to the north, and most of the tombs have been cleared but the explorers had on their hands masses of fragments which once decorated them, and to fit these together was an Egyptian puzzle and not a Chinese one. From the bodies of soldiers remarkable information was obtained as to the nature of early Egyptian warfare. The work-tent took on some of the gruesomeness of a field dressing station — only the front was 4000 years away. The Theban bows and arrows were deadly, as were the stones from slings.

Most of the work centered around the Temple of Deir el Bahri. An important discovery of scarabs dispelled all doubts as to whether Hatshepsut founded the temple (1501–1479 B.C.). Her daughter married Thutmose III, and the mother-in-law kindly acted as regent and assumed the kingship and kept it after he reached majority. She was a prototype of Catherine of Russia and other female potentates. She built the temple to justify her assumption of the rule and depicted herself as a man. One of her chief supporters was an architect and engineer named Senmut and he gratified her desire for display. Alongside the entrance was a quarry from which stone was obtained for the construction of the temple and it was into this quarry that we find the statues and bas-reliefs glorifying the queen, thrown there after her irate son-in-law rose in rebellion at her usurpation. Senmut dug his own tomb and made it extend under the temple with a secret burial place which he never occupied, as he was probably done away with by the prototypes of the modern gunmen.



EMBRYO SAILORS

One of our modern naval training stations—San Diego, California. Before a newly-enlisted man is assigned to the fleet, it is necessary for him to have a period of training in the elementary essentials of a seagoing life

Naval Adequacy—V

Personnel Is a Primary Element of Naval Strength. In This, the Final Article of This Discussion, the Author Points Out Our Need for More Men

By CAPTAIN N. H. GOSS, U.S.N.

HAVING previously discussed naval bases and ships of the various types and classes with their relation to each other, we now come to the third primary element of naval strength—personnel. Regardless of ship strength, a navy depends on personnel, for a battle decision may rest on numbers and quality of men. After all, the men do the fighting, and a long line of records in history shows that good men in poor ships are better than poor men in good ships, unless outclassed in numbers.

Of the three principal naval powers that have been the basis of these discussions, Great Britain and Japan have an inherent advantage in the matter of personnel, because each is a homogeneous people and is and has been a sea-faring nation through centuries of tradition and practical experience. Each is through necessity a sea-faring nation because it is dependent on sea communications for vital articles of food, raw materials, and the trade on which its prosperity depends.

The natural conditions in this country are considerably different. Our well-being and prosperity have come so naturally in the past through natural expansion and development of resources within our own borders that we have not felt the same necessity for development at sea. Our population, too, is heterogeneous and lacks the same community of interest as the others under discussion.

While, obviously, it takes time to build a ship, the fact that it also takes time to train personnel is not so generally recognized. The requisite time in our case is actually longer, too, because of the very fact that we are not an experienced sea-going people and hence our naval personnel, in addition to their specialized duties, have to learn also the rudimentary habits and customs of a life at sea.

IT is, of course, a matter of common knowledge that Great Britain possesses, incomparably, the greatest and most numerous merchant marine in existence; also that Japan possesses a very large and experienced merchant marine. This country, however, due to such various causes as general apathy, widespread prosperity, restrictive shipping laws, and lack of the same preference in favor of our merchant ships that our tariff policy has extended in the past to other industrial efforts, has failed to build up a merchant marine comparable in extent with the sea-borne trade of the country. Hence it lacks a great natural reserve of sea-going personnel such as that from which the British and Japanese are able to draw men and augment the strength of their specialized professional naval personnel.

This being the case, it might be expected that our practice would be to give greater permanence to the naval personnel which we do develop and train, but actually the reverse is true. While both the British and the Japanese have felt a sufficient need of permanence for their specialized naval ratings to make their normal period of enlistment 12 years, our enlistment term is normally four, and somewhat less for those enlisted for minority.

Thus it might naturally be expected that this country has a relatively larger naval personnel than that of the British and Japanese; but again the contrary is actually the case.

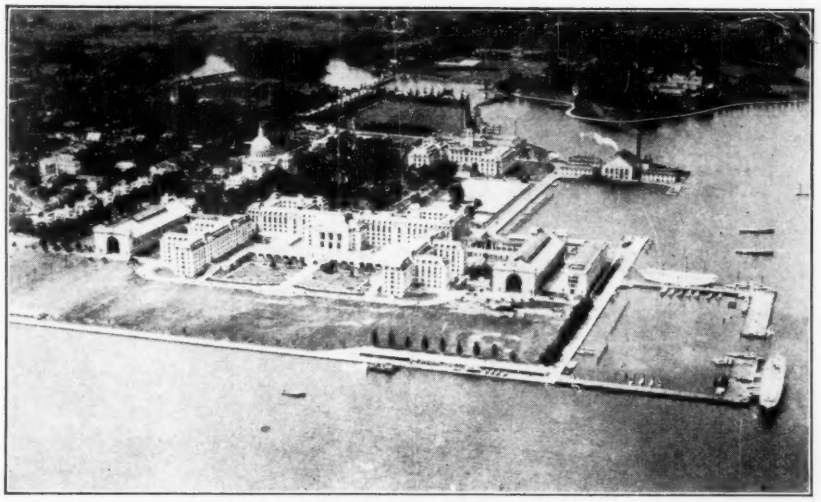
Other factors also enter into the naval personnel situation: this country is definitely committed to a purely de-

fensive and non-aggressive foreign policy; it has never contemplated war as an instrument of aggressive policy; it has never looked forward to war as a means to an end but has always regarded war as a means of last resort; it has never considered entering it until all other means have been exhausted and war, alone, remained the only way of defending our rights. Hence there never has, nor will there ever be, any question of specially developing numbers of personnel with any definite conflict in view.

NEVERTHELESS, to a country whose commercial interests are as far-flung as ours and whose sea trade reaches all quarters of the globe and is, in fact, the greatest in volume in the world, the navy must be, and is, the first line of defense. But the navy will not be equal to the task of preventing encroachments upon our rights or of defending our interests, unless its personnel is adequate.

Past experience has shown that conditions leading towards war develop quickly, so that in a national emergency there would not be time to train additional naval personnel. History records that actual attacks have occurred even before the formal outbreak of war, that short notice ultimatums have been served which left no time even for mobilization, so that an opportunity to prepare especially for an emergency is not to be expected and cannot be counted upon by those responsible to the country for its naval defense.

Our experience in the World War had, in some ways, a misleading result since, during that conflict, we were able to prepare ships and train large numbers of naval personnel after the declaration of war. The reason for this was that the German fleet was already blockaded by the Allied navies.



WHERE OFFICERS ARE MADE

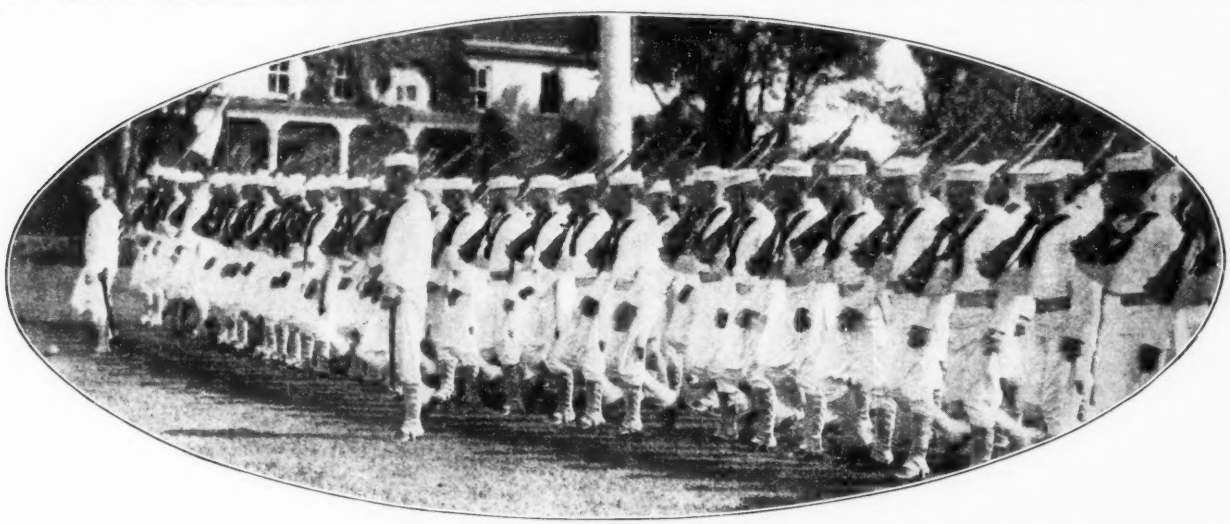
The United States Naval Academy at Annapolis, Maryland. At this institution, which may justly be called the University of the Navy, men are given thorough training for naval leadership

The important lesson to be learned from this is that we were actually so weak in personnel that it was necessary to devote our entire battle fleet to the sole purpose of training men. We were so deficient in trained personnel that it was necessary to detach officers and men from our first line battle-ships in order to furnish the armed guards supplied to our own merchant vessels.

Naturally the high quality of personnel available in time of war learned the rudiments more quickly under these conditions, but it is surely not to be expected that in a future emergency we will have an allied fleet holding the enemy at bay until we can train new personnel to fill out our deficiencies; and no personnel material, however high in quality, can be effective unless adequately trained.

Since we are not a sea-faring people, our naval personnel has to be trained in everything, beginning with the rudiments of life aboard ship. Newly-enlisted recruits are first sent for a few months to one of the naval training stations, of which we have three—at Newport, Hampton Roads, and San Diego—in active commission, with one at Great Lakes, near Chicago, in reserve.

TO learn the elementary essentials of a sea-going life requires not less than six months, and although the newly-enlisted recruit arrives aboard ship in less time than that, it is that long before he begins to be an asset. To make him a valuable and dependable man-o'-war's man requires not less than two years. Therefore, about half of the normal enlistment period of four years is consumed before a first-enlistment man is of any great value. To make petty officers, as the ratings corresponding to non-commissioned army officers are known at sea, requires con-



THE SAILORS' LAND TRAINING

The Naval Training Station at Newport, Rhode Island. Three of these stations are in active service and one in reserve. This early land training usually requires several months for a newly-enlisted man but it takes about two years to make a dependable man-o'-war's man of him

TYPE	United States			Great Britain			Japan		
	*No. V.	L. O.	E. M.	No. V.	L. O.	E. M.	No. V.	L. O.	E. M.
Capital Ships	18	918	21,776	20	1,036	24,998	10	526	12,800
Light Cruisers	18	416	8,626	62	1,236	26,954	29	551	12,058
Old Cruisers	22	352	9,900	9	135	3,150	15	345	10,300
Mine Layers	4	30	1,164	0	30	1,164	0	18	699
Destroyer Leaders	0	0	0	18	180	2,700	24	240	3,600
Destroyers	276	1,932	30,360	164	1,148	18,040	83	581	9,130
Old Destroyers	33	165	2,310	6	30	420	12	60	840
Fleet Submarines	9	54	711	20	120	1,580	26	156	2,055
Submarines	50	200	1,950	29	116	1,131	45	180	1,755
Old Submarines	27	81	783	23	69	667	10	30	290
Tenders and Repair Vessels	21	159	5,098	21	159	5,098	13	95	3,050
Staff duties afloat		180	1,103		180	1,103		108	661
Other Auxiliaries	53	205	5,415	53	205	5,415	31	123	3,249
Total	531	4,692	89,196	425	4,644	92,420	298	3,013	60,487

*No. V.—Number of Vessels. L. O.—Line Officers. E. M.—Enlisted Men.

TABLE 1

siderably longer—from four to six years normally and in some cases, longer.

The navy today is composed almost completely of specialists. More than 40 specialties are employed aboard ship, each of which does work of a highly technical character requiring special training and experience. Many of these specialties are found only aboard ship and require the services of gun pointers, range-finder men, fire-control men, gyro-electricians, radio direction-finder men, quartermasters, torpedo men, signal men, and the various engine and fire-room specialists necessary to operate the delicate and high-speed steam, electric, and internal combustion machinery.

SINCE weights and space must be limited in a ship, boilers must be of the high-pressure type and the turbines high speed. As an example of power generated and controlled in a modern vessel, our modern cruisers develop about 100,000 horsepower; our new plane carriers develop 180,000 horsepower—more power in the hull of a single vessel than is utilized in any except perhaps the half dozen larger cities in the country; and even a destroyer, within the confines of its small hull, develops 28,000 horsepower. All this is in addition to the machinery for operating turrets, guns, and for controlling gun fire. Since this machinery is found only aboard ship, all personnel to operate it must be trained by the navy itself since no outside training would be properly specialized.

To assist in training for these special ratings, the navy operates service training schools on shore at the various training stations and at some of its specialized industrial plants, but training men for these duties obviously requires time, and this, plus the necessity for actual experience aboard ship, is the reason why a modern sailor—really a trained specialist—cannot be made overnight. With our system of short enlistment this process has to be repeated over and over again as men come and go. This is not entirely without value, however, since men discharged back into civil life do constitute some reserve of experienced sea-going men.

IN time of war, the personnel of the navy naturally has to be greatly expanded in order to take care of large numbers of auxiliary vessels, fuel, store, and supply ships, tugs, mine sweepers, et cetera, necessary to maintain the fleet, and on which this country, because of its lack of well-located naval bases, must depend.

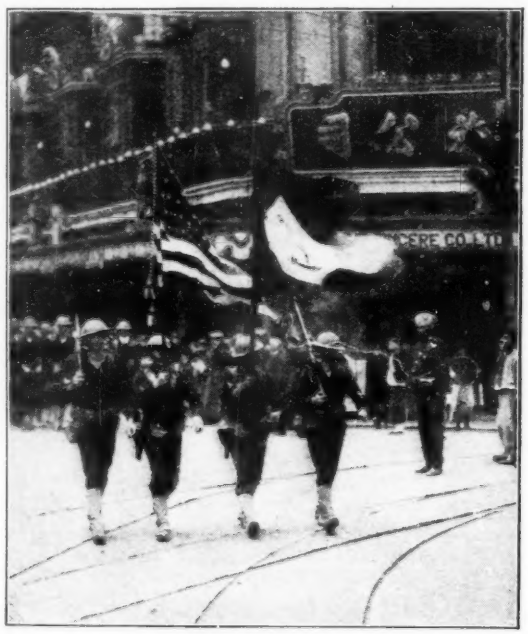
The first problem then is to obtain a nucleus of the necessary officers to control these additional vessels. Many of these are drawn from the more experienced, higher ratings of the enlisted personnel who, because of their experience, have the necessary qualities to make valuable officer material for the lower grades. But this very thing operates as a handicap in assimilating and training large numbers of newly-enlisted men since it is these same petty officers that are of the most value in training new recruits.

The problem then of training these large numbers of men, however great may be their potential value due to the high quality of our material, is a large one as indicated by the fact that, in the World War, our navy expanded to a force of more than 500,000 enlisted men.

The natural source of officer material is the Naval Academy at Annapolis. After four years of scholastic training there, augmented by practical drills and exercises and three summer cruises aboard regular vessels of the fleet, midshipmen are graduated into the commissioned service. Their development into valuable officers, however, has then only begun and it requires a number of years more before they are sufficiently experienced to be entrusted with responsible positions.

OFFICERS, too, are trained in some of the more important naval specialties such as engineering of various kinds, radio, electrical propulsion, internal combustion engines and also, for example, in ordnance, fire control, and torpedoes. Thus we see how the process of training goes on for a number of years after the midshipmen leave Annapolis, in order to develop a selected corps of highly trained specialists on which the navy may depend for improvements in design of vessels and their equipment. Later, too, selected numbers from the higher grades are trained for the duties of higher command at the Naval War College.

We have previously discussed the various types of vessels and the classes and numbers of each type which compose the fleet. It might, perhaps, be assumed that the personnel strength of the navy in officers and men is sufficient for at least the normal peace time complements of these vessels, but such is not the case, as will be shown. If the navy possessed suffi-

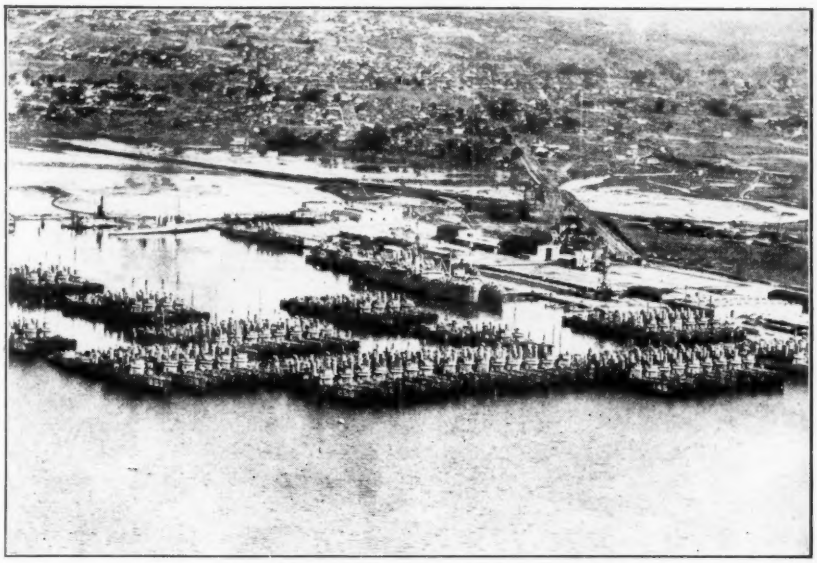


IN A FOREIGN LAND

Maintaining our rights abroad. An American landing force of sailors in Shanghai, during a Chinese civil war

cient personnel to man its existing combatant vessels, its problem on the outbreak of war would be comparatively simple since it would then only need to man the necessary auxiliaries required to support the fleet.

Actually, however, many of our men-of-war are laid up, out of commission, due to lack of personnel with which to man them, and at the outbreak or near approach of war, our Navy Department would be faced with the problem of manning not only the great numbers of auxiliary vessels required but also an immense number of fighting vessels. The accompanying tables and the discussion which follows include numbers of line officers and enlisted men required to man the authorized vessels of the existing fleet with a normal or peace-time complement only. They do not include the augmented numbers that would be required in war-time for additional watch and other duties.



WITHOUT PERSONNEL TO MAN THEM

Our only potential reserve, surplus destroyers, helplessly immobilized at San Diego, California, because we have insufficient men. Other destroyers are immobilized at Philadelphia

FOR purposes of comparison with our own, the numbers required to man the existing authorized British and Japanese fleets are also included in Table 1, using the same standards of personnel for the various types and classes used for our own vessels.

In this tabulation, certain selected auxiliaries have been included with our fleet. More important among these are the tenders for destroyers and submarines, and repair vessels. Without these, our destroyers, submarines, and light craft such as fleet tugs and mine sweepers could not operate away from their home yards which, as we have seen in previous discussions, are not located with reference to our probable theaters of war operations. The only other auxiliaries included are the few supply vessels, transports, oil tankers, fleet tugs, and mine sweepers actually in commission in peace-time, the personnel of which could only supply a very small nucleus of the supply and transportation force necessary in war.

For strict purposes of comparison, the same relative allowance has been made for the British fleet and the same, in proportion, for the Japanese, although actually, due to their interior lines and abundant bases, they do not have needs similar to ours. Table 1 shows the total number of officers and men required by the three nations to man the existing authorized fleets and to provide a small nucleus for auxiliaries.

The total shown for the United States does not include aircraft or the personnel necessary to man our plane carriers, aircraft tenders, and naval air stations on shore. To man these and the equipment being built under the so-called Five-year Naval Aircraft Program, now well advanced towards completion, requires roughly 1,000 officers and 10,000 men.

The actual figures under the present operating plan but not including personnel manning planes aboard our battle-ships and cruisers which were included with their regular complements, are 864 officers and 8598 men.

	United States		*Great Britain*		*Japan*	
	*L. O.	E. M.	L. O.	E. M.	L. O.	E. M.
Fleet, including Air Force	5,556	97,794	5,508	101,108	3,350	65,645
Shore Establishment	1,786	16,658	1,786	16,658	1,071	9,995
Under Training	243	7,004	243	7,004	145	4,203
Grand Total	7,585	121,456	7,537	124,680	4,746	79,843

*L. O.—Line Officers. E. M.—Enlisted Men.

TABLE 2

For purposes of comparison, the same numbers relatively are used for the British and Japanese fleets, although the British with their separate air service do not use strictly naval personnel for this purpose.

To support and maintain a fleet at sea, a shore establishment of the navy is necessary. This includes naturally the officers on duty in the Navy Department, at the navy yards, at the Naval Academy, and the officers and men at the various naval operating and supply bases on shore, submarine bases, fuel and ammunition depots, at the naval radio stations, on other essential communication duties, at the naval training stations and service schools, the staff and students at the Naval War College, and officers under other post graduate instruction; all attending to the thousand-and-one details on shore necessary to supply, equip, and maintain the fleet at sea.

Experience has shown that about 20 percent of the total of enlisted personnel is required for these duties. Actually, with every shore activity cut to the bone in order to maintain in commission as many vessels of the fleet as possible, this ratio has been reduced in peace time to about 18.5 percent.

AT present, the number of officers and men assigned to shore duty are 1786 and 16,658 respectively. An additional 243 officers are under training and specialized instruction at the Naval War College and in other post-graduate courses; while 7004 enlisted men are at the naval training stations and at various schools for specialist ratings.

Combining these figures we find, in Table 2, the number of line officers and enlisted men required for the normal complements for the authorized vessels of the fleet with only minimum peace-time shore activities.

These figures do not include some of the normal naval peace time activities afloat such as the smaller patrol vessels employed in the Caribbean and Central American region, the river gun-boats stationed in Chinese waters, or vessels engaged in hydrographic surveys for the purpose of

WHERE OFFICERS ARE TRAINED FOR HIGHER COMMAND

The Naval War College at Newport, Rhode Island. Each year, selected groups of naval officers are sent to this institution where they are trained for the duties of higher command

making new charts. The officers and crews for these are taken from the complements of some of the combatant vessels now laid up out of commission. It may be emphasized again, also, that the small numbers assigned to auxiliaries are only a very small proportion of the number that would be required for this service in war. Actually, more than the number shown would be required for additional tenders and repair vessels alone and without which our destroyers and submarines, now out of commission, could not operate in any principal theater of war.

HAVING detailed the numbers required to man the existing navies, it is interesting now to turn to the regular naval personnel actually available to each country which is:

	United States	Great Britain	Japan
Line Officers	5449	4285	5281
Enlisted Men	84,410	92,646	72,681

These numbers, too, are somewhat misleading since the British actually have a separate air force and have a special permanent shore organization which takes the place of much of the naval personnel which we employ on shore. So actually we find that the British and Japanese are fortunate in having quite a larger proportion of both officers and men.

Having investigated the regular naval personnel situation we may next consider what naval reserves each power under consideration has available to draw upon for manning ships now laid up, and as a nucleus for manning the immense numbers of auxiliary vessels required to maintain its fleet in war.

Present naval reserves are approximately as follows:

	United States	Great Britain	Japan
Officers	5414	10,951	3464
Enlisted Men	26,425	64,897	40,388

These reserves are of much value but this country is relatively much weaker in effective naval reserves than the British or Japanese since they have also an enormous reserve of trained sea-going personnel in their merchant fleets to draw upon, while in this country we have not sufficient merchant marine to man the hundreds of merchant vessels laid up already.

Our authorized enlisted personnel are easily kept up to strength but officers, due to decreased output of the Naval Academy and peace time resignations, number only about 5300. The last congress authorized an increase in the number of midshipmen of approximately 20 percent but these will be required primarily to care for increased aviation demands so that few additional men will be available to man sea-going vessels.

We believe we have no reason to fear comparison of the quality of our naval personnel nor of our naval vessels but if, as at present, we have comparatively less trained personnel to man the ships we already possess, we cannot but suffer in comparison of actual naval strength with the British and also with the Japanese since their fleets are comparatively so much more fully manned and since their positions so near to our detached possessions, coupled with their abundant and well located naval bases, confer on them such great natural advantages.

LONG ago the British learned the value of trained personnel. Since the days of their French wars when their more efficient personnel, trained under St. Vincent, was able, under Nelson, to overcome the individually superior vessels of the French, they have seen to it that their fleet did not lack sufficient numbers of efficient personnel. The Japanese learned the same lesson under Togo in the Russian war when their superior personnel was able to overcome superior numbers.

They have learned by experience the lesson which is apparent to those in this country who are interested enough to look for it: which is that a vessel laid up, out of commission, of however great potential value, has no present actual military value. Since this non-aggressive country will never make special preparation with any definite conflict in view, the only safe way seems to be to train and maintain in peace time sufficient personnel strength to make our fleet in commission strong enough to be an effective insurance against war and a dependable first line of defense in event of war.

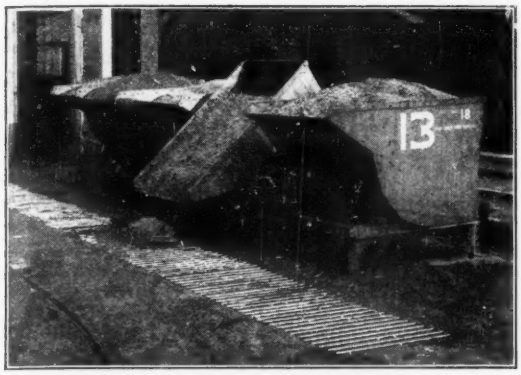
THE END

THE TRAINING CONTINUES AT SEA

After the naval recruit has received land training and is assigned to a ship, his training becomes more intense and specialized. The illustration shows an inspection aboard a battleship

Saving The Scraps

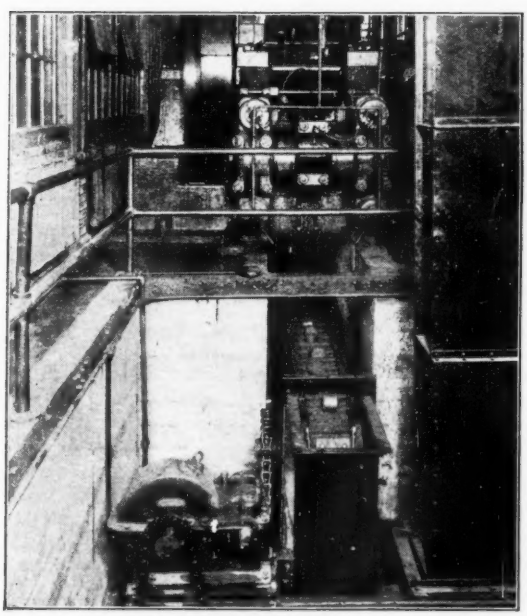
Cast-Iron Chips and Borings Briquetted For More Efficient Re-melting



DELIVERING THE TURNINGS

One-ton hopper dump cars deliver cast iron turnings and chips to a floor grid over a horizontal conveyor

IN the production of automobile and other engines, agricultural implements, machine tools, and almost any machinery, a certain amount of the iron is cut away from castings to leave finished surfaces and establish accurate dimensions, just as wood is wasted when the trunk of a tree is cut into usable sizes of boards or timbers and when the lumber is planed or cut for building construction or furniture making.



THE CONVEYOR SYSTEM

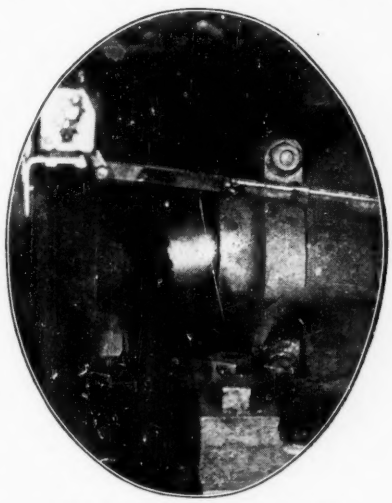
Horizontal and vertical conveyors transfer briquettes to bins on cupola charging deck

In iron-using industries, it has been common practice to collect the cast-iron chips or borings and sell them as scrap. According to present market quotations such cast iron and semi-steel borings are worth about nine dollars per ton at Gary or Pittsburgh or other steel making centers.

It is because attempts to re-melt cast iron and semi-steel borings in the ordinary foundry cupola have been so unsuccessful that common practice has been to sell them as scrap. A few foundries have experimented with enclosing the borings in metal containers. But when the containers melt under the intense heat of the cupola, there is a heavy loss through burning of the finely powdered iron or blowing out through the stack under the forced draft.

In the foundry of Dodge Brothers, Inc., such borings are now being compressed into briquettes, in which form they can be re-melted with no more loss than with new foundry iron. A pressure of over 300 tons is exerted in forming a briquette four inches in diameter and three and one half inches long. The volume of the finished "iron biscuit" is less than one-third the volume occupied by the loose borings and the briquette weighs about 8 pounds, or from 75 to 85 percent as much as a piece of solid cast iron of the same dimensions. Under the intense pressure exerted, the borings, without any binder, stick so firmly together that the briquette is about as resistant to shock as an ordinary building brick.

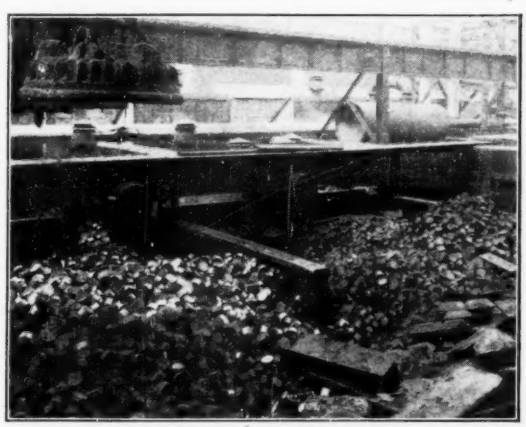
The facts that a rough casting for the cylinder block of an average six cylinder car weighs about 200 pounds and the finished block weighs about 150 pounds and that a rough flywheel casting weighs 70 pounds and, when finished, 50 pounds, indicate the amount of loss which takes place in ordinary practice and the amount which can be saved by the new process. The machine, the only one in America used for briquetting cast-iron borings, it is stated, has a capacity of 50 tons of briquettes per day and the entire cost of operation is only about two dollars per ton. It is pointed out that the character of the product of the foundry is benefited by the re-melting of this material which, before being previously poured into castings, was known to conform to the chemical specifications prescribed by the foundry chemists.



OUT COMES A BRIQUETTE

A briquette, made without binder under a pressure of 300 tons, leaving machine

On this page, some of the elaborate equipment for making and handling the briquettes is shown. The photograph at the bottom of the page is particularly striking because it shows the convenient size of the briquettes, *en masse*, and one of huge overhead electro-magnets which handle them as easily as if they were ordinary solid pieces of scrap iron.

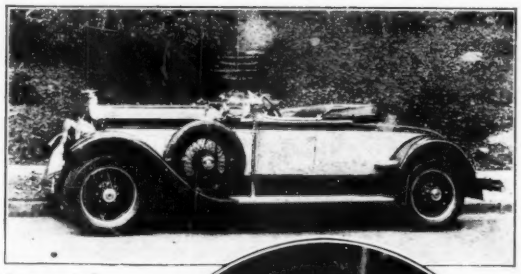


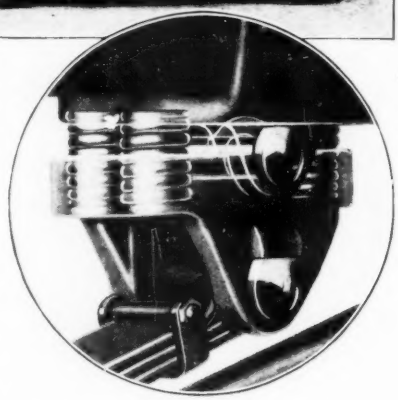
READY FOR RE-MELTING

Briquettes issue from the conveyors—left center—to this dump where they are handled by electro-magnets

Your Next Automobile

Few Mechanical Improvements But a Wide Variety of Body Designs and Colors Are Features for 1929

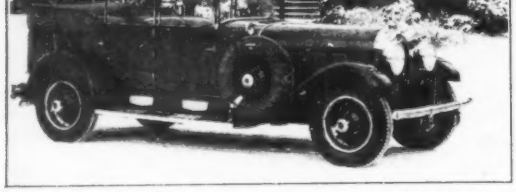




PACKARD

The attractive Packard eight roadster, the body of which is custom-built by Rollston. Below is a phantom view of the trunnion spring bracket for damping vibration

ADVANCE information about the 1929 models of American automobiles indicates that they will be but little different in any respect from those we see on the streets every day. Most manufacturers apparently have felt that there is little room for improvement of mechanical features and have concentrated their attention on exterior design and finish. Some cars have changed radically in appearance in an attempt to appeal to the esthetic sense of the purchaser—or his desire for variety, as you will—while some have excused themselves for their lack of new models by the argument that they thus protect owners against obsolescence of present models.



AUBURN CONVERTIBLE FIVE-PASSENGER

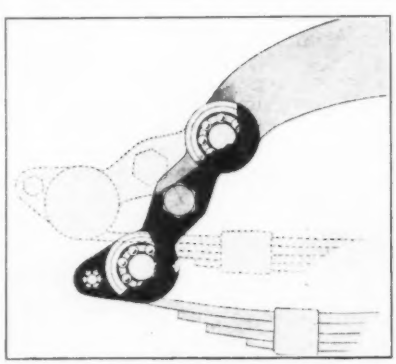
With top, side glass, and columns down, this model is a regular open car. When all are up, it is a sedan

The lines of the new cars vary between wide extremes. In general, an attractive yet conservative mean has been attained but some cars show a greater tendency than heretofore toward long, streamline effects which give the impression of trim fleetness; and quite the reverse, one is built with what have been called "voluptuous" curves. There will be a greater choice of colors this year than ever before.

THIS will be welcomed by the many who, noting the tendency toward gayer colors in almost every article in common use, have wondered why most cars were available only in somber, neutral finishes. Louvers are horizontal on many of the new models. Monograms of several have been changed; on one or two they have changed position; and one in the higher price range which has never used a nameplate has created a crest for the radiator shell.

It will be noted particularly that chromium has been adopted by a great many manufacturers as a plating metal for radiators, trim, et cetera. Chromium plate, which has a grayish, silvery sheen and extremely high luster, has the advantages over nickel of being rust-proof and corrosion proof. When properly applied, chromium protects the base metal indefinitely, will not peel, nor will abrasion wear it off since it is the hardest metal known: it is harder than tool steel. Since there is so much plated trim on present-day cars, however, it is said that the use of chromium has been the cause of the narrowing down of the radiator shells so noticeable in the new models; the high luster had to be subdued in some way.

So far as we have been able to learn in our survey, few radical improvements in vital parts have been effected, although some are worth noting here. Automobile engineers nowadays seem more interested in refinements in the design of parts affecting the riding qualities, vibration, et cetera. Some of these features will be discussed, together with descriptions of the more striking body designs.



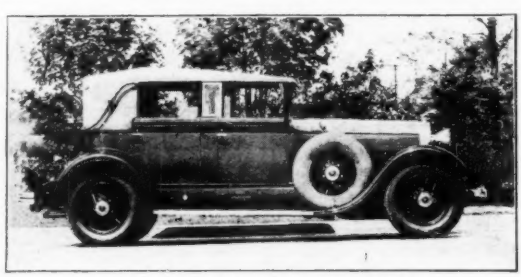
STUDEBAKER SHACKLE

A side view of one of the new ball-bearing shackles now standard on Studebakers

Perhaps the most outstanding development for improving riding quality is the Packard trunnion spring bracket assembly which prevents steering wheel kick and shimmy. This condition, prevalent since the advent of the balloon tire which, because of its resiliency, absorbs shocks even from the smoothest pavements and sets up a synchronized vibration known as front wheel shimmy, has occupied the attention of the entire motor industry for years. Packard engineers, while studying the problem, drove a foreign car which could not be made to vibrate in this fashion.

THEY discovered that the bracket fastening the rear end of the left front spring to the frame had become loosened. When this was tightened, the car immediately shimmied. With the bracket loosened again, the car again refused to shimmy. Thus after further study, the Packard device was evolved—the result of an accidental discovery. It consists of a bracket containing four heavy steel springs which allow just enough movement of the left front spring to dampen out the road shocks transmitted through the balloon tires to the front wheels.

Final results were obtained through the combination of the new spring bracket, the original Packard idea of



LINCOLN CONVERTIBLE SEDAN

A smart double-purpose car which reflects the distinctiveness of the Lincoln cars. Body is custom-built

placing the shackles at the front end of springs, the under-slung front axle, and the new Packard hydraulic shock absorbers. With road shocks eliminated from the steering mechanism, Packard was able to put ball bearings on each side of the steering sector, thus making what has been declared to be effortless steering regardless of the speed.

Packard officials state that no new models other than those announced last fall, will be exhibited at the New York Automobile Show in January, 1929.

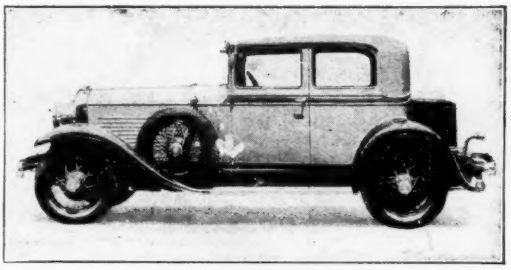
Studebaker will introduce no innovations at the show, but the first cars equipped with the new ball-bearing spring shackle—which is exclusive with Studebaker and has been adopted as standard for all models—will be shown. Developed by engineers of the company, this shackle has been tested for a year in the laboratory and over nearly 200,000 miles of road. The manufacturer claims that no lubricant except the original grease was used during the entire test and that, at the end of the tests, the shackles showed no wear.

THUS with these, Studebaker engineers claim that the necessity for frequent lubrication, wear, and noise has been eliminated.

A distinctly new body design, hitherto unobtainable except on special order from custom coach builders, has been brought out by Auburn. This is the phaeton convertible sedan. It is a full five-passenger model with a special collapsible top that can be put down readily to convert it into a touring car. The windshield pillars and center pillars are unusually narrow and can be removed when the top is down and the glass sides are down. When the top is up, this car is a regular five-passenger sedan.

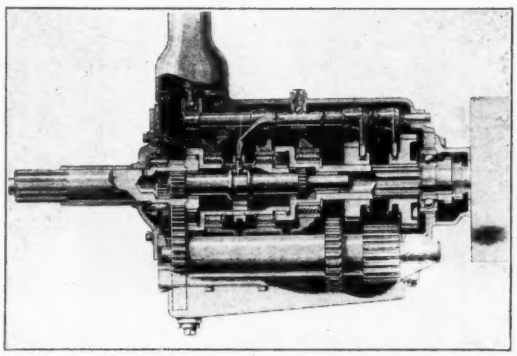
Duesenberg, Incorporated, a subsidiary of Auburn, exhibited early in December, new models in the higher price class designed by Fred S. Duesenberg, famous racing car builder. A 265 horsepower motor of the straight-eight type powers these new cars, a standard open model of which has been driven 116 miles an hour, and 89 miles an hour in second speed.

Many features of the Duesenberg are entirely new to car owners. For example, it has an altimeter which not only serves to indicate the altitude of the country through which the car is traveling but also acts as a barometer. More important is the automatic lubricating system and the series of lights which indicate the action of the system. Every point of the chassis is automatically lubricated from a central point. Oil is forced into chassis bearings after every 80 miles, a green light flashing when the operation has been successfully completed. If the operation takes place but no oil is forced into bearings due to lack of supply, a red light flashes. Outstanding features of the cars are their power, long sweeping lines, and harmonious design. One other point worth noting is that, besides the radiator and trim, almost every chassis part except the frame and the axles is chromium plated, even to the exhaust manifold.



MARMON "78" VICTORIA

The graceful lines of this four-passenger Victoria are quickly apparent. It embodies many improvements



GRAHAM-PAIGE FOUR-SPEED GEAR BOX

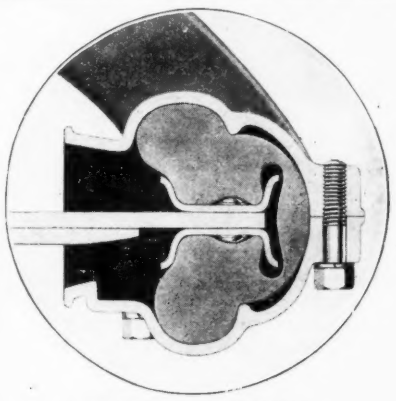
New four-speed transmission makes possible high road speeds at low engine speed and improves performance

Another car that was on exhibition early in December is the Lincoln Aero Phaeton, designed by LeBaron. In this may be seen the first automobile with a true airplane motif. Its long wheelbase, horizontal louvers, low-swung chassis, sweeping fenders, plated disk wheels, seats following the lines of airplane cockpits, and a rudder-like projection in the rear, show the appropriateness of the designation "Aero." With the exception of this model, the Lincoln Motor Company will announce no fundamental alterations in 1929.

The Marmon Motor Car Company announces a new series of its two lines of straight-eight cars, the new series Marmon "68" and "78." Many mechanical refinements have been made in these models, including a vibration-absorbing clutch in the "78," insulated manifold, more expensive bearing construction, and refinements in spring suspension.

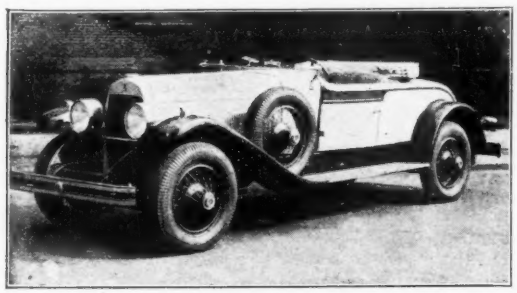
THE vibration-absorbing clutch plate, exclusively on the Marmon "78," eliminates the vibrations that tend to shatter the gears and, in addition, gives a damping action that cuts vibration in the driving line. This result is effected by the use of high grade rubber inserted between the driving hub and plate.

Graham-Paige Motors Corporation claims it has something of interest to exhibit at the Automobile Show. Permission to publish descriptions prior to the show, however, was refused. But the four-speed transmission, developed for use on the three series of six-cylinder cars as well as on the eight, illustrated herewith, is noteworthy. The manufacturers say that their new high-geared rear axle insures low engine speed at high road speeds, the quiet, internal-gear third speed providing excellent acceleration and hill-climbing ability. The Graham-Paige is regularly started in second speed, first speed being used only in mud or sand. In third speed



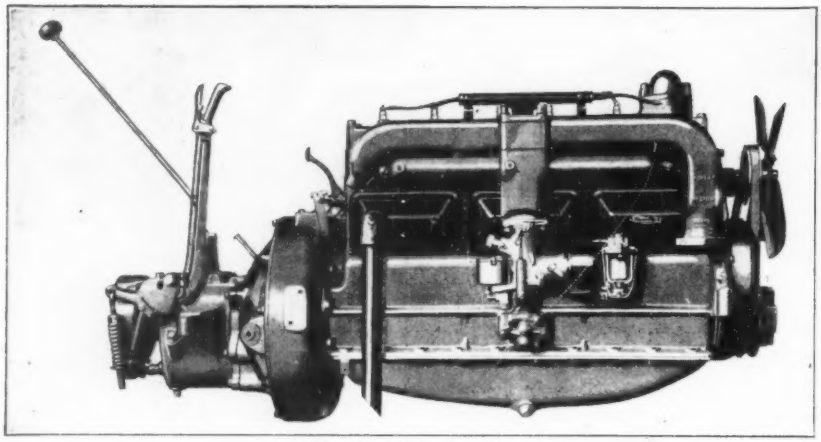
CHRYSLER SHACKLE

Spring ends of "65," "75," and "Imperial 80" are anchored in blocks of live rubber



DUPONT ROADSTER

Beauty of line as well as comfort mark this smart new model which is one of the new eight-cylinder duPonts



OAKLAND POWER PLANT

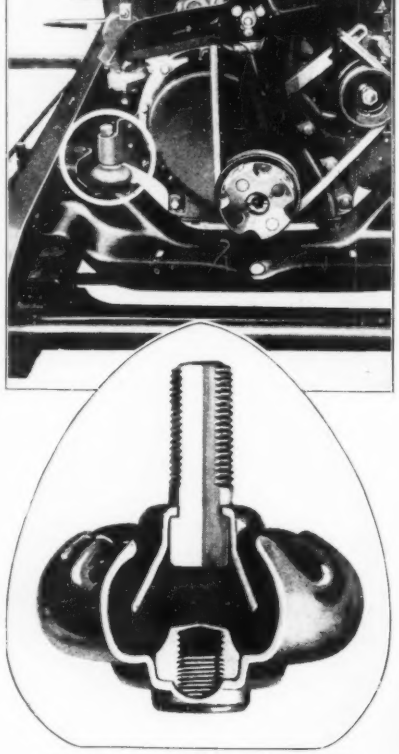
Right side of the improved Oakland engine showing the larger carburetor, new oil-wetted air cleaner, and gasoline pump that supersedes the vacuum tank. Note engine supports

this car is said to have pulling power ordinarily obtained by second speed, yet this third speed is capable of driving the car at 50 or 60 miles an hour without the usual gear noises.

Chrysler has brought out the Isotherm Invar piston for the "65," "75," and "Imperial 80," which, through the modification of the Invar strut piston head and the application of tongue and groove piston rings, effects a revoiutionary kind of piston cooling, an advanced mode of cylinder wall oiling, and new provisions for combustion sealing. Other significant mechanical advancements have been made by Chrysler this year but lack of space prevents our mentioning any of them except the rubber mounted engine of the "Plymouth," the smart new four-cylinder model that has set the "dress" style for the newer cars. This mounting involves a three-point support, with the single point in front and the two rear ones, each built of interlocking "U" sections separated by a rubber cushion.

THE new duPont, introduced but a few months ago, has been accorded an enthusiastic reception. It belongs in the higher price class, has a 141-inch wheelbase, and an eight-in-line L-head type motor. It develops 125 horsepower at 3200 revolutions per minute.

The new All-American six announced by Oakland recently is new and original in outward appearance and has many chassis refinements. Prominent among these, are the improved power plant with larger cylinder displacement, new internal-expansion four-wheel brakes, sturdier frame, Lovejoy hydraulic shock absorbers, and improved steering mechanism. On test, the power plant has developed 68 horsepower at 3000 revolutions per minute. To minimize transmission of vibration to the chassis and decrease noise, the engine is mounted on four supports, each completely insulated from the frame by a rubber "biscuit," leaving no metallic contact between engine and frame. Another feature used for the first time this year is the



OAKLAND ENGINE SUPPORT

Above, in circle, is the rubber "biscuit" support and below is a sectional view of it

provision, on the frame, for integral bumper mounting.

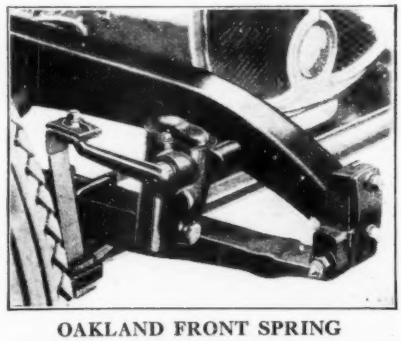
Buick will exhibit no new models at the show this year. Precedent in line and color treatment, however, has been ignored by Buick, and although the new bulging body styles have been criticized by some people, others like them because of the greater roominess. One innovation added by Buick is an adjustable driver's seat. By shifting a simple, conveniently placed lever, the seat may be pushed forward or backward to suit the length of the driver's legs.

Perhaps the most outstanding development of the year is the new series of six-cylinder Chevrolet cars to take the place of the present four-cylinder line which will now be discontinued. Seven models of passenger cars and three commercial types comprise the line.

Included in the passenger series are five closed and two open models, no one of which is more than 30 dollars above the price of the four-cylinder model which it replaces. In this new line, all bodies of which carry the famous Fisher stamp of craftsmanship, a new convertible landau sedan supplants the imperial landau and a phaeton takes the place of the old touring car.

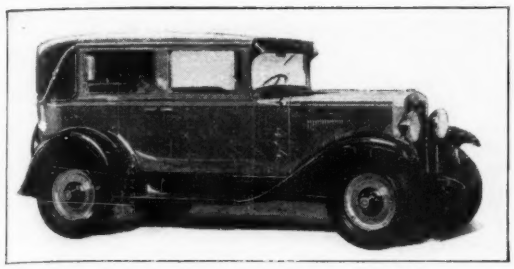
IN this new offering Chevrolet has retained the highly successful valve-in-head principle. The motor is of the high compression type with a non-detonating head and is said to develop 32 percent more power than its predecessor. The speed has been stepped up to satisfy maximum requirements, and, in acceleration, the new motor is superior to any previous Chevrolet model. This remarkable acceleration is due partly to the use of a new accelerating pump. When the accelerator is suddenly depressed, this pump forces a small quantity of gasoline into the manifold of the carburetor, giving the car the instant power and getaway so necessary in modern traffic. On actual dynamometer tests the new engine develops 46 horsepower at low engine speed. At all ordinary speeds it is said to develop from three to four times the amount of power required to drive the car. It is also said that, under ordinary driving conditions, the new engine will show an economy of better than 20 miles to the gallon of gasoline.

In the new engine the heavy 46-pound crankshaft, balanced statically and dynamically, makes torsional vibration imperceptible at all speeds. Thus this engine is very quiet in operation. Au-



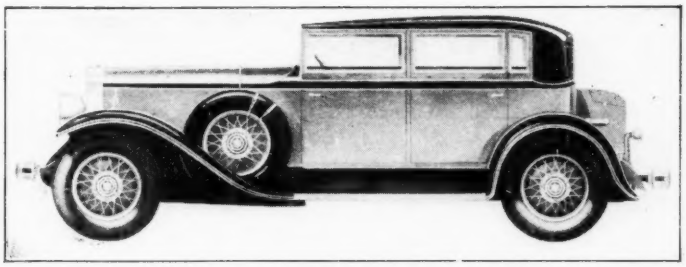
OAKLAND FRONT SPRING

View illustrating integral bumper mounting and the hydraulic shock absorbers



CHEVROLET CONVERTIBLE LANDAU

This convertible landau in the six-cylinder series takes the place of the former four-cylinder imperial landau



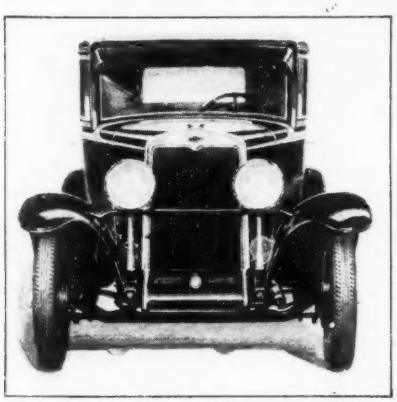
FRANKLIN GENTLEMAN'S SPORT SEDAN

This body design classic on the Franklin chassis is by Derham. It is finished in Caribbean red with six wire wheels in Bengal yellow, and black leather roof

tomatic lubrication of the entire rocker-arm mechanism and of all valve-operating parts conduces further to quietness of operation.

Chevrolet engineers have installed in the new engine a new type of AC air cleaner; a new method of self purification of the crankcase oil; an improved system of crankcase ventilation; and a new rear axle which has a 3.8 to 1 gear reduction between the engine and the wheels. The new rear axle is similar in design to that used on high-priced cars.

All the new Chevrolet models are equipped with the Alemite lubrication system, theft-proof ignition locks, fixed-focus type headlamps operating from the lighting switch with a toe button dimming control, and a number of other new features too numerous to mention here. The dimming control is a button switch located at the left of the clutch pedal, by means of which the light shaft may be deflected. Another noteworthy feature is that



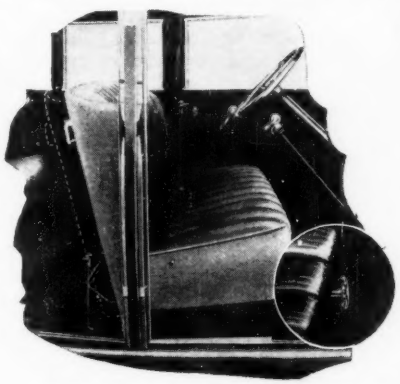
CHEVROLET FRONT

Note the sweeping fenders, chromium plated trim, and other features of the new models

all closed models of the new Chevrolet six have adjustable driver's seats. All models have non-locking four-wheel brakes and also rear service brakes in two self-aligning segments.

The air-cooled Franklin is one of the few cars that will show distinctly new models this winter. Four of the country's leading custom body designers and builders — Willoughby, Dietrich, Derham, and Holbrook— will exhibit coach-work on the Franklin chassis at the custom salons. Willoughby's contribution is an all-weather town car; Dietrich's, a convertible victoria brougham; Derham's, a gentleman's sport sedan; and Holbrook's, a convertible coupé. Besides these models, Franklin apparently will announce nothing radically new this year.

Stearns-Knight is another that will exhibit three new models on its straight-eight chassis. Two of these, by Brunn, are: a convertible coupé and an all-weather cabriolet. The



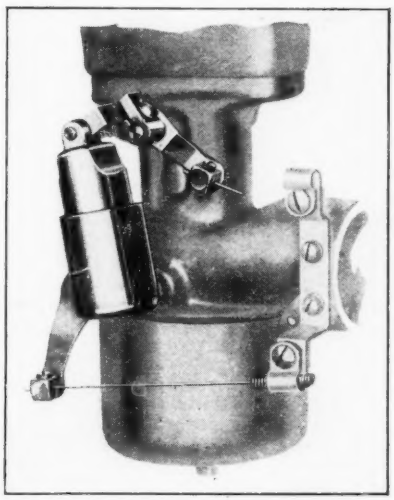
CHEVROLET ADJUSTABLE SEAT

Device for adjusting driver's seat to the length of driver's legs, on closed models

third, by Judkins, is an enclosed drive limousine.

The Kissel Motor Car Company will announce no new features or models. It is to be remembered, however, that this company pioneered in many points of design, noteworthy among which is the cushioning in rubber of springs, motor, and other major units.

Velie also will have no new models or improvements to exhibit.



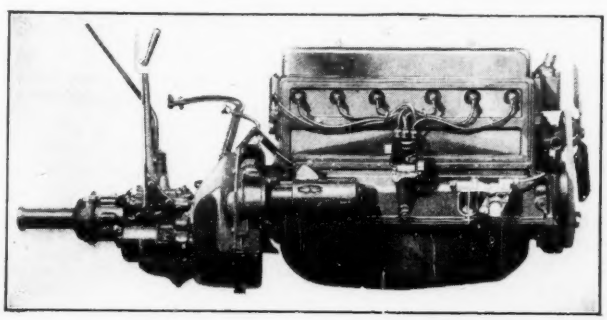
CHEVROLET ACCELERATING PUMP

A new device which gives better "get-away" when the accelerator is depressed quickly

Information on other cars was promised but, unfortunately, did not reach us in time to be included in this survey although the time allowed for its preparation was a full month. In this group are: Oldsmobile, Cunningham, Hupmobile, Pierce-Arrow, Reo, Locomobile, Jordan, Chandler, Cleveland, and Stutz. The Nash Motors Company stated that it would be impossible for them to release this information to us so far ahead of the show; McFarlan was discovered to be bankrupt; and other manufacturers of whom information was requested, failed to answer our inquiries. This last class, including the lower priced cars such as Ford and Whippet, apparently has nothing significant to announce.

CHEVROLET MOTOR AND TRANSMISSION

View of the right side of the new six-cylinder motor. The motor has a three and five sixteenths inch bore and a three and three quarters inch stroke. It has a high compression, non-detonating head and is fully enclosed. It is claimed that the new six develops 32 percent more power than the discontinued line of fours



Wheels—III

Steering Wheel Linkages, Castor Settings of Wheels, and Reasons for Wheel Wobble Are Discussed In This Installment

By P. CORMAC, F.R.C.Sc.I., M.R.I.A.
University College Dublin

(Concluded)

MANY devices have been invented to give deflections to the steering wheels so that their axes intersect on the back axle produced. Jeantaud's modification of Lenkersperger's invention was simply to set the steering arms so that, instead of being parallel in the mean position, they converge to some point on the propeller shaft. Jeantaud's gear is shown in Figure 21, December, 1928, issue. With this setting of the steering arms, the necessary excess deflection will be given to the inner steering wheel on a curve. This can be seen from the fact that when the coupler is pulled over to deflect the wheels, Figure 22, the effective lever arm, that is, the perpendicular from the steering pivots on the coupler, increases for the outer wheel and diminishes for the inner wheel. Hence, as with a small pulley and a large one connected by belting, the wheel with the smaller lever arm is deflected the more. The equivalent pulleys for the

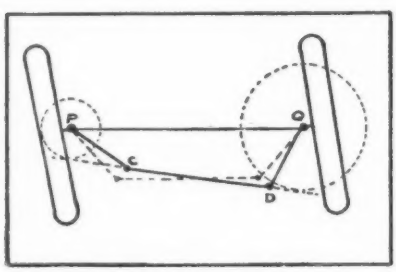


FIGURE 22

In this almost universally used linkage, the inner wheel turns more than the outer

Jeantaud linkage in the position of Figure 22 are shown dotted.

This linkage, however, gives but approximate concurrency to the wheel axes. Deflections are correct in but two positions. The first position, of course, is when running straight. The second is when the wheels are deflected to an angle usually in the neighborhood of 30 degrees. From zero to 30 degrees of lock, the deflection given to the inner wheel is less than that necessary for concurrency. Beyond 30 degrees the deflection of the inner wheel is greater than that required for concurrency. The gear thus gives the steering wheel axes intersecting some two feet behind the back axle at the beginning of the steering movement, intersecting on the back axle when the deflection of the inner wheel is 30 degrees, and intersecting some two feet in front of the rear axle at the angle of maximum lock.

The length of the steering arms and the track rod are calculated to insure this. The rate of growth of the error becomes very rapid for large deflections. Where uncommonly large deflections are to be provided for, as in long wheelbase trucks and in taxicabs, the track rod should be placed on the outside of the axle; in this case the steering arms diverge as from a point on the propeller shaft, the track rod being some two inches longer than the pitch of the steering pivots. With the outside track rod, the rate of growth of the error for large deflections is less than with the inside coupler.

FOR correct steering to obtain when running straight or nearly straight, the steering arms should converge to a point on the propeller shaft at a distance equal to half the wheelbase from the track rod. This holds both for inside and outside track rods, and incidentally shows that a blunter setting of the steering arms is necessary with the outside track rod. Usually the point towards which the steering arms converge in their mean position lies farther to the rear, thus giving correct steering on sharper curves. A setting which gives correct steering for a deflection θ of the inner wheel is to make the steering arms converge to a point distant $(w + 2\ r)$ divided by $(1 + 1.63 \cos \theta)$ from the front axle. In this formula, w is the wheelbase or distance between front and rear axles, r is the length of the steering arm and is to be taken as positive for an inside coupler and negative for an outside coupler. The design formula given may be used to calculate the angle at which an existing gear gives correct steering.

The Lavenir concave pentagon gear, Figure 23 (a) and the Jenatzy divided coupler, Figure 23 (b) are improvements on the accuracy of the Jeantaud gear. Both these designs are valuable in trailer steering in which a tractor bar, pivoted at *R*, rotates *RB*, with it when curving. The divided coupler becomes essential with the independent suspension of steering wheels recently introduced.

A steering gear giving mathematically correct conditions was invented by Bourlet. This mechanism is shown in Figure 24. Here the coupler was placed in guides so that it could slide across at a fixed distance in advance of the front axle. Pivots at the ends of the coupler operated in slotted levers, forming the steering arms. The arms are set so as to converge to a point at a distance equal to the wheelbase in advance of the front axle. The great drawback to this gear lies in the sliding joints. Wear of these and the consequent rattle when worn render

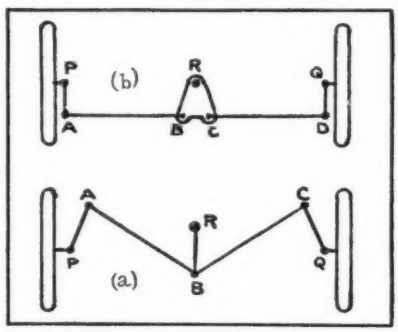


FIGURE 23

These two forms of steering wheel linkages — see text — are improved types

it less suitable than the approximately correct linkages consisting entirely of turning pairs.

To reduce the lever arm of the road resistance and shock on striking obstacles, the steering pivot is sloped so that it points downwards and outwards. In Figure 25 the center line *KV* of the pivot is shown passing through the point of tire and road contact. Generally, however, the point of tire contact will be from three eights to three inches outside the trace *V* of the pivot axis *KV* on the ground. The common view that there is no swerving effect due to road resistance, when the pivot axis passes through the center of the tire contact area, is incorrect. To protect the wheel from the swerving effect of road resistance, the pivot axis should strike the ground outside the point of tire contact, or else the pivot should be given a forward rake sufficient to bring its trace on the ground at the effective center of contact which, as we have seen, is some .2 to .3 inches ahead of the center line.

OCCASIONAL obstacles on the road may, for the moment, give this point a much greater advance; an obstacle one inch high places it five and one half inches in front of the geometrical center. It is, however, undesirable for two reasons to have a true center-point setting. An out of center setting makes it easier to turn the steering

wheel with the car moving slowly. This is because the turning of the wheels in the steering sense causes as well a rolling motion of the wheels around the pivot trace. The ease, due to tire creep, in turning the steering wheels of a car in motion, as compared with turning the wheels on a stationary car, is well known and comes into play here.

THE second reason against centering the pivot over the center of tire contact is that it makes the shock on the stub axle due to road irregularities unduly great. With the pivot off center, the first effect of a blow on the tire is to swerve the wheel. The elasticity of the steering gear and its reversibility allow of this taking place to a certain extent and the inertia of the wheel in taking up an angular deflection absorbs a large part of the effect of the blow so that but a cushioned effect reaches the stub axle.

With inclined king pins, without, however, true center-point steering, the weight of the car tends to return the wheels to the straight as in the case of the scooter. But the restoring couple due to weight is extremely feeble with the usual settings.

In addition to pointing downward and outward the king pins point some two to fifteen degrees forward. This gives a nominal castor effect of from one half inch to four inches so that the wheels trail as in the bicycle or furniture castor. In this castor action both wheels must be considered as one unit. This means that castor setting will not obviate serious consequences in the event of breakage or disconnection of the steering linkage unless it be combined with a setting which gives true center pivot steering. Center point steering has a real advantage in

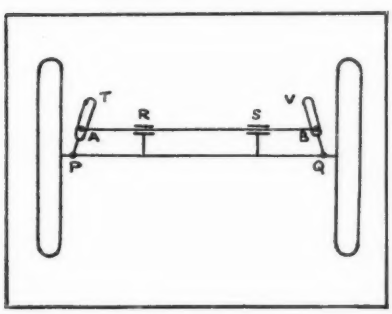


FIGURE 24

The Bourlet gear uses undesirable sliding joints, but is mathematically correct

safety in the event of a burst tire and again in tire durability.

A second method of obtaining castor action is to offset the hub axes behind the plane of the steering pivots. An offset of one and one half inches is used on some continental cars.

Castor action is the principal cause of the tendency of wheels to straighten out automatically after curving and mainly on account of the centrifugal force of the car. Castor setting is illustrated in Figure 26.

We must now draw attention to a further refinement in the setting of automobile steering wheels. The setting referred to is known as toe-in. Measured in front, the tires are one third to three eighths of an inch nearer together than at the back of the axle. This setting can be adjusted by altering the length of the track or tie rod. It gives stability to the straight course and helps in straightening out the steering after turning.

THE action of toe-in in lending stability to the straight course of the vehicle is illustrated in Figure 27. Both mid-pivot and divided-pivot systems are shown. Taking the motion to be in the direction of the arrow and assuming the left wheel to be retarded by an obstacle, the wheels are so deflected that the left wheel becomes edge on to the obstruction while the

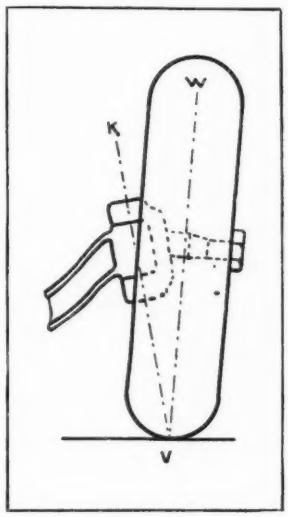


FIGURE 25

True center point setting is undesirable for the two reasons mentioned in the text

right wheel is put more broadside on to the direction of motion. The right wheel thus partly rolls and partly drags over the road, thus developing a resistance which counter-balances that due to the obstruction at the left wheel. Once the obstruction is passed, the extra resistance at the right wheel will pull the steering back until both wheels are again traveling with equal broadside on as originally.

The geometrical inaccuracy of the ordinary steering linkage of the automobile adds virtually to the toe-in for small angles of lock.

Want of sufficient toe-in in a horse carriage or trap manifests itself in a continual swaying of the shafts to right and left. The action of toe-out on front auto wheels may be observed when reversing, or better when steering a car running backwards down a grade, or again by a model toy cart run on a sloped board.

The interplay of forces and inertias in front automobile wheels give rise to a vibration called wheel wobble. The steering wheels and gear deflect rapidly right and left, and the front end of the car vibrates in sympathy. Speed

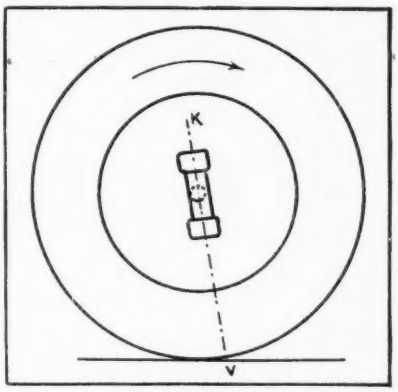


FIGURE 26

Castor setting, shown here, causes wheels to straighten automatically after steering

wobble has the same frequency as, and is accompanied by, criss-cross vibration of the front axle; that is, a vibration in which one end of the axle is up when the other end is down. This crosswise axle vibration may have either a high or a low frequency. The high frequency (ordinarily about 250 to 500 per minute depending on the car) occurs under the combined action of tire and chassis spring forces. The low-frequency oscillation occurs as a forced vibration of small amplitude as the axle follows the swaying of the chassis on its springs. This frequency is of the order of 100 to 150 per minute. In addition, certain road waves running askew across the wheel tracks so that one wheel is on a crest when the other is in a trough, will give a criss-cross vibration, the frequency of which depends on the car speed and wavelength.

IN experiments by the author on a Ford car, the axle vibration frequency was 250 per minute. The chassis side-sway vibration had a frequency of 144 per minute. The steering oscillation in a wobble developed by this car had a frequency of 250 per minute, thus verifying the isochronism of wheel wobble and axle vibration. The wobble occurred at about 11 miles per hour; that is, at a wheel frequency of 125 revolutions per minute. It would appear that the wheels initiated a chassis oscillation, the secondary harmonic of which forced a sympathetic oscillation on the axle, or out of round (elliptical) wheels gave an axle vibration of twice the wheel frequency.

In an endeavor to throw further light

on this phenomenon, the front of the chassis was jacked up so that the axle assembly depended from the front spring. The axle frequency was now determined by the tuning of an oscillation forced by hand on the wheel hub. Both wheels were then set in rapid rotation by pulling off a length of cord previously coiled round the hubs. Upon

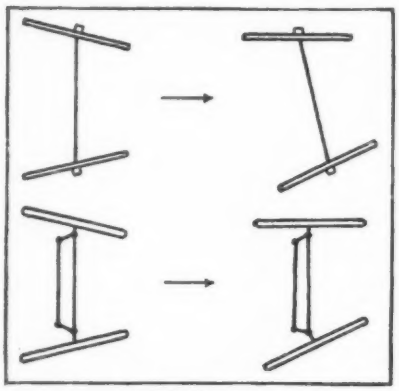


FIGURE 27

When steering wheels toe in, the effect is to keep the vehicle on a straight course

causing the front axle to oscillate, the wheels were observed to turn in and out in the same period. Again, if the steering wheel was oscillated by hand at axle vibration frequency, a violent isochronous criss-cross vibration of the axle was set up.

Want of balance in wheels or tires, or tires out of round would initiate and sustain this type of axle vibration when the revolution speed of the wheels coincided with the natural frequency of the vibration. A pair of unbalanced tire valves weighing five ounces, would, at 10 inches radius, give a force of 50 pounds on each wheel, causing a rocking couple on the axle of over 216 foot-pounds at 45 miles per hour. At nine miles per hour, the unbalanced force on each wheel is two pounds and the rocking couple nearly nine foot-pounds.

NOT merely static balance but also dynamic balance of wheels is essential if this source of vibration is to be eliminated. A wheel may be in static balance but not in dynamic balance. Ordinarily the weight of the valve puts a wheel out of static balance; that is, the wheel will come to rest with the valve at the bottom. Some makers balance the valve so that there is no tendency for any part of the wheel to swing to the bottom when free to rotate on a jacked-up axle. For dynamic balance, the tire and rim must be symmetrical with respect to the axle. If, in replacing a rim, the bottom be pulled farther on than the top, we get a wheel with dynamic unbalance. Such a wheel appears to wobble when rotating; it is the askew setting of the tire that gives this appearance; the wheel itself does not turn in and out in the steering sense.

There is, however, a couple acting on such a wheel when running, the direction of the couple being such as would tend to pull the rim on straight. Such a couple will therefore tend to turn the wheels in and out in the steering sense, and, in addition, to rock the axle. The main cause of the turning in and out of the wheels in wheel wobble arises, however, from gyroscopic action.

A model constructed by the writer to illustrate the gyroscopic action of a front axle assembly is shown in Figure 28. Rapid spin can be imparted to the wheel by coiling a short piece of twine about the hub and pulling it off quickly. If the apparatus be now set vibrating as a pendulum about the horizontal axis through *A*, we get a display of gyroscopic effects. It will be observed that the wheel oscillates about the axis *KK* in such a manner that the hub traces out an ellipse in the reverse sense to the wheel spin; that is, the circulation of the hub is in the opposite direction to the wheel spin. This motion of the hub is called precession.

WHEN the pendulum is at the extremity of its swing, the wheel is passing through the middle of its swing about the axis *KK*. When the pendulum is vertical, the wheel is turned through its maximum angle about *KK*. It will be noted that the period of the pendulum vibration is considerably lengthened beyond what obtains with the wheel not rotating. This arises from the fact that the gravity-restoring couple on the pendulum which hurries it back from its extreme angle of swing is partly neutralized by a gyroscopic couple arising from the swinging of the rotating wheel about *KK*. The reduced resultant restoring couple on the pendulum generates reduced acceleration with a consequent increase in the time of the journey.

A second mode of vibration of this system is possible if properly started. In this mode, the wheel hub describes its ellipse in the same sense as the wheel spin. But now the gyroscopic couple due to the turning of the wheel about *KK* conspires with the gravity couple in hurrying the pendulum back from the end of its excursion. The increased acceleration generated results in the journey being accomplished in quicker time so that the period of this mode of vibration is shorter than the natural period; that is, the period without spin. As the hub describes its ellipse in the time of a vibration, we have a fast precession with the fast vibration, and a slow precession with the slow vibration. The two modes of vibration may therefore be referred to as fast precessional motion and slow precessional motion.

The behavior of the assembly under the action of an external force which should tend to hurry or to retard the precession depends on whether the precession is of the fast or slow type. For the slow precession we have Kelvin's rule: Hurry the precession and the top rises, retard the precession and the top falls. For the fast precession exactly the reverse rule holds. Applying the rule to the axle assembly, we find that hurrying the slow precession or retarding the fast precession causes the wheel to rise, augmenting the amplitude of the vibration and wobble, while delaying the slow precession or hurrying the fast precession causes the wheel to fall, minimizing and ultimately annihilating the vibration and wobble.

THE results, which have a very important bearing on the practical applications of gyroscopic apparatus, and on the problem in hand, may be verified by the model. The auto wheel is put "sleeping" (running without wobble) by hurrying the fast precession or by delaying the slow precession just as a top "goes to sleep" by the hurrying of its slow precession or by the retarding of its fast precession.

The equations of motion of a front axle assembly are of the same form as the equations for the Schlick device for steadying a ship at sea; these will be found in Gray's "Gyrostatics and Rotational Motion." Substituting average numerical values in the equations of motion, we find that the frequency of the fast precession increases but slightly with the car speed, and is at the usual speeds but little greater than the natural frequency of the crosswise vibration of the axle. Further, this frequency depends but little on the restoring couple on the tires; that is, on the "straightening out" effect.

The frequency of the slow precessional vibration, at a car speed of 45 miles per hour, is in the neighbor-

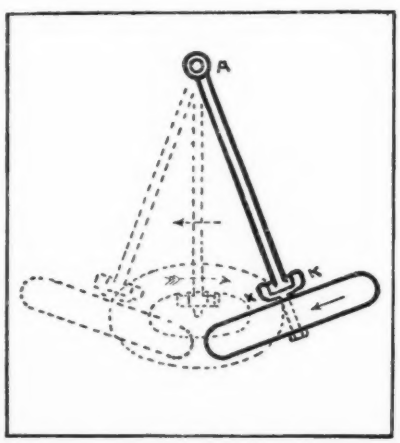


FIGURE 28

Gyroscopic pendulum illustrating wheel wobble. Drawn from model by author

hood of 20 per minute, becoming less as the speed rises. Wobbles of this low frequency have not been reported, while there is considerable evidence to show that wobble of the higher frequency exists. We therefore conclude that high-speed wheel wobble is a case of fast precessional gyroscopic motion.

Remembering that fast precessional motion of the axle assembly is amplified by retardation, it is not surprising that inventors have been unsuccessful in finding a complete cure for this disturbance. (It may be shown, however, that fluid frictional damping forces do not tend to the instability of the system). The axle assembly requires hurrying of the fast precessional in order to reduce and ultimately annul it, or in other words to put the wheel sleeping. The slow precessional motion of the axle assembly is minimized and ultimately annihilated by retarding the precession, so that, ordinarily, tire and road reaction would quickly damp out this vibration.

It must be remembered that high-frequency wheel wobble may occur at any car speed. It is only when the axle disturbance arises from unbalanced wheels that a definite connection exists between speed and wobble. In all cases, however, the velocity in feet per minute is the wavelength of the road track multiplied by the axle frequency. For an automobile having an axle frequency of 500, we may expect wheel wobble at about 45 miles per hour if due to wheel irregularity, for at this speed the road wheels are making 500 revolutions per minute.

TURNING now to the low frequency of the axle vibration, that is, the forced vibration following chassis sidesway of from 100 to 150 swings per minute, we may remark at once that as the amplitude of this vibration is small, it will not usually give rise to wheel wobble unless there be slackness in the bearings and king pins, which, as far as the wheel is concerned, is equivalent to an increase in the amplitude of the axle swing. What has been said already of the precessional motions for high-frequency axle vibration applies here also.

We may have a wobble with a frequency of 100 to 150 per minute corresponding to fast precessional motion, or a wobble with a frequency in the neighborhood of 30, corresponding to slow precessional motion. The latter wobble would be quickly annulled by the natural forces between tire and ground, tending to retard the precession.

A point of importance bearing on the initiation of wheel wobble is that, to have gyroscopic apparatus exhibit fast precessional motion, the system must be properly started. The right wheel surmounting an obstacle and at the same time receiving a glancing blow giving it angular velocity inward about the king pin would appear to be favorable to the development of wobble.

The wobbles just discussed are seen to depend on the criss-cross vibrations of the front axle under spring action or forced oscillation. But with force action entirely left out of account, there is a natural mode of vibration of the steering wheels and front axle which partakes of a criss-cross vibration of the axle and turning in and out of the wheels in the steering sense. This is known to mathematicians as conical precession without torque.

It may be realized with the model of Figure 28 by continuing the stub axle above KK so that the center of gravity of wheel and axle is on KK, and then continuing the pendulum bar above A so that the centroid of the whole assembly is at A. Without rotation, the whole system is then in neutral equilibrium. With the wheel spinning and the pendulum properly started, steady isochronous oscillations about A and KK are possible, in which the restoring couple is a gyroscopic couple.

FIGURE 29

Gyroscopic action of spinning wheel aids when inverting a bicycle as shown here

Plainly, the mode of vibration here must be such that the gyroscopic couple at maximum pendulum displacement tends to restore it to its mean position. It is, therefore, the fast precessional mode which circulates in the same direction as the wheel spin. If properly started this type of vibration may be maintained by a front axle assembly. The equations of motion are now practically the same as before, with the couple terms omitted. Numerically we find the wheel revolution frequency to be in the neighborhood of 2.6 times the wobble or precession frequency. We are not aware if a wobble having this relation to the wheel speed has been met with.

If, however, we take the case of a loose king pin, or axle bearing, so that the wheel is free to precess about a horizontal diameter, the two moments of inertia concerned are those of the wheel about its axis and about its diameter, and we find the wheel frequency to be half the wobble frequency. As axle vibration isochronous with this wobble would be favorable to its development, we might expect it to be pronounced when it attains axle vibration frequency. As the wheels would be revolving at half this frequency, this would account for a wobble occurring at approximately half the speed of the ordinary high-speed wheel wobble.

A YOKING of the king pin which keeps it parallel to itself throughout the usual range of spring play, would, to a large extent, eliminate the above sources of wheel wobble. There would yet remain various effects which in favorable circumstances would give front-wheel wobble. For example, vibration of the chassis results in movement of the end of the drag link, which, with an improper setting, is moved towards and away from the steering arm. Thus, as the chassis vibrates, the wheels are constrained to deflect in and out to accommodate the varying position of the drag link. The wobble may have the same frequency as the chassis vibration, or it may have double this frequency. The double frequency will arise when the drop arm end is nearest the king pin in the mean position of the chassis oscillation.

We shall conclude by noting some of the effects of the pitching motion of the car, or what may be called "nose-diving." The frequency of this motion lies between 120 and 150. It has been stated that this is without effect on wheel wobble. We shall show, however, that motorcycle and motor-car wheel wobble may arise and be sustained from this cause. In pitching, the front axle rotates alternately with and against the wheel spin. The axle rotates with the wheel as the car nose-dives; it rotates against the wheel as it recovers.

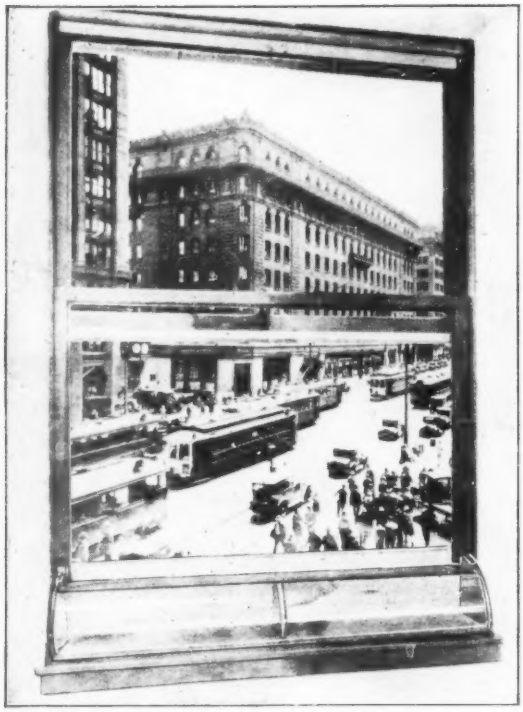
This remarkable action of similar and dissimilar wheel and stub-axle turnings is well exhibited by the model shown in Figure 28. If the wheel be spinning anti-clockwise and the supporting rod be turned about its axis in the same direction, nothing strange is noticed. If, however, the pendulum rod be rotated about its axis against the spin of the wheel, at once the wheel kicks up about KK.

A useful application of this principle is illustrated in Figure 29. In turning a bicycle upside down, the front wheel usually falls away awkwardly out of the plane of the frame. If, however, the front wheel be given a spin opposite to its usual running direction, it may be inverted over the rear wheel quite comfortably, the front wheel remaining steady in the plane of the frame. In bringing the machine back, the wheel must be spun in the other direction. Theoretically the speed of turning over should not exceed twice wheel speed.

THE END.

Noise Exclusion

Sound Waves From Noisy Streets Deflected by New Ventilator Which Admits Silent, Fresh Air



VENTILATOR TRAPS NOISE

Double reflectors permit fresh air to enter a room, but exclude the sound waves from noisy city streets

EXCLUDING street noises in congested business districts is closely allied with the problem of providing adequate ventilation for offices, factories, and other buildings. Were it not for the noise, the most economical and satisfactory method of providing fresh air would be by the simple process of opening a window. But every day new evidence appears to substantiate the belief that noise causes nervous strain and reduction in efficiency. In addition to this, noise must be blamed for considerable loss of health as a result of workers being confined in stuffy rooms due to the obvious fact that adequate ventilation frequently means an increase in the noise that enters with the fresh air.

AS described in an article by Dr. Donald A. Laird in our December issue, tests with an audiometer developed by the Bell Telephone Laboratories show the intensity of noise entering a room through opened windows. These experiments reveal that a single window opened half way increases the noise in the room by approximately 40 percent.

Among the recent efforts made to devise a practical method of reducing noise in offices, the work done by Dr. J. F. Newsom is significant. For a number of years Dr. Newsom has directed his attention toward designing and perfecting a device that will provide adequate ventilation, but will exclude or muffle the sound waves from adjacent sources of noise.

Recognizing the difficulty of a practical solution to the problem, his initial step was an investigation into the nature of sound waves of varying frequencies. After observing the effects of reflected waves in a mercury bath, shields were designed that would effectively blot out waves of a certain height and frequency, corresponding to "intensity" and "pitch" in actual sound waves.

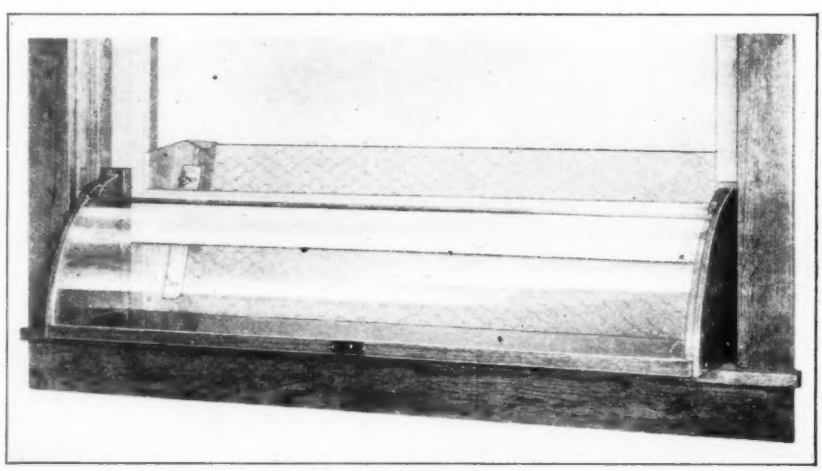
However, the problem was still far from solution, for street noises are of a multitude of frequencies. It was necessary to devise a method of measuring ear-drum annoyers such as those caused by surface cars, trucks, motor cars, horns, and whistles.

With the aid of a radio test-set equipped with a microphone of unusual sensitivity, it was comparatively easy to register the human voice, and certain other sounds. But it failed to furnish the necessary information about other important noises, such as the crash of a street car at an intersection.

The difficulty was met by using a Dorsey Phonelscope, which was installed in a second floor room at Leland Stanford University. By this device, the sound waves are caught in a horn and concentrated against a diaphragm, which is thus set in vibration. The vibrations move a small mirror which plays a reflected beam of light on a scale. By noting the readings on the scale, it is possible to obtain a comparative measure of the amplitude or intensity of the sound waves.

AFTER a series of tests calculated to show the nature of sound waves entering a window from various angles, a "window-muffler" was designed by which the sound waves are actually reflected back from the window-opening, in much the same way that light waves are reflected back from a polished surface. It was also found that the most efficient design is that using a double reflector placed at the proper angle in the window opening. Further tests showed it advantageous to have the inside shield curved in concave form, in order to reflect back the vibrations that would get past the outer shield. Testing the muffler on a fourth floor window, it was found to exclude about 75 percent of the noise coming up from the street.

While science seeks more practical methods of deadening and reducing noise at the source, office workers will welcome a practical means of excluding the roar and clamor of the machine age without reducing the necessary supply of fresh air.



LESS NOISE FOR OFFICE WORKERS

The device shown in this picture excludes about 75 percent of the exterior noise, allowing an adequate supply of fresh air to enter offices and hotel rooms through an open window

Long Bridge Shortens Coastal Route

▲ **COMPLETED END**

In this photograph, taken at the completed end of the five and one half mile bridge, details of the piling and other construction are clearly apparent. The elevating span may be seen in the background at the extreme left

LAYING THE ROADWAY ➤

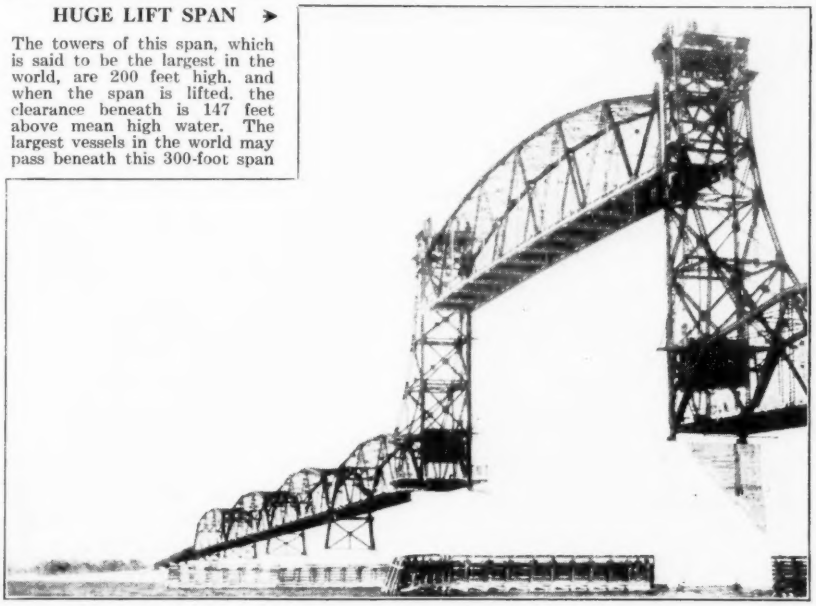
This striking view was made during construction of the concrete roadway. What appears to be a lighthouse in the far distance is the lift span which is but three quarters of the distance across. Motorists are now using the bridge

BENEATH THE LIFTED SPAN

This is what the motorist on the roadway near the span will see when it is raised

HUGE LIFT SPAN ➤

The towers of this span, which is said to be the largest in the world, are 200 feet high, and when the span is lifted, the clearance beneath is 147 feet above mean high water. The largest vessels in the world may pass beneath this 300-foot span



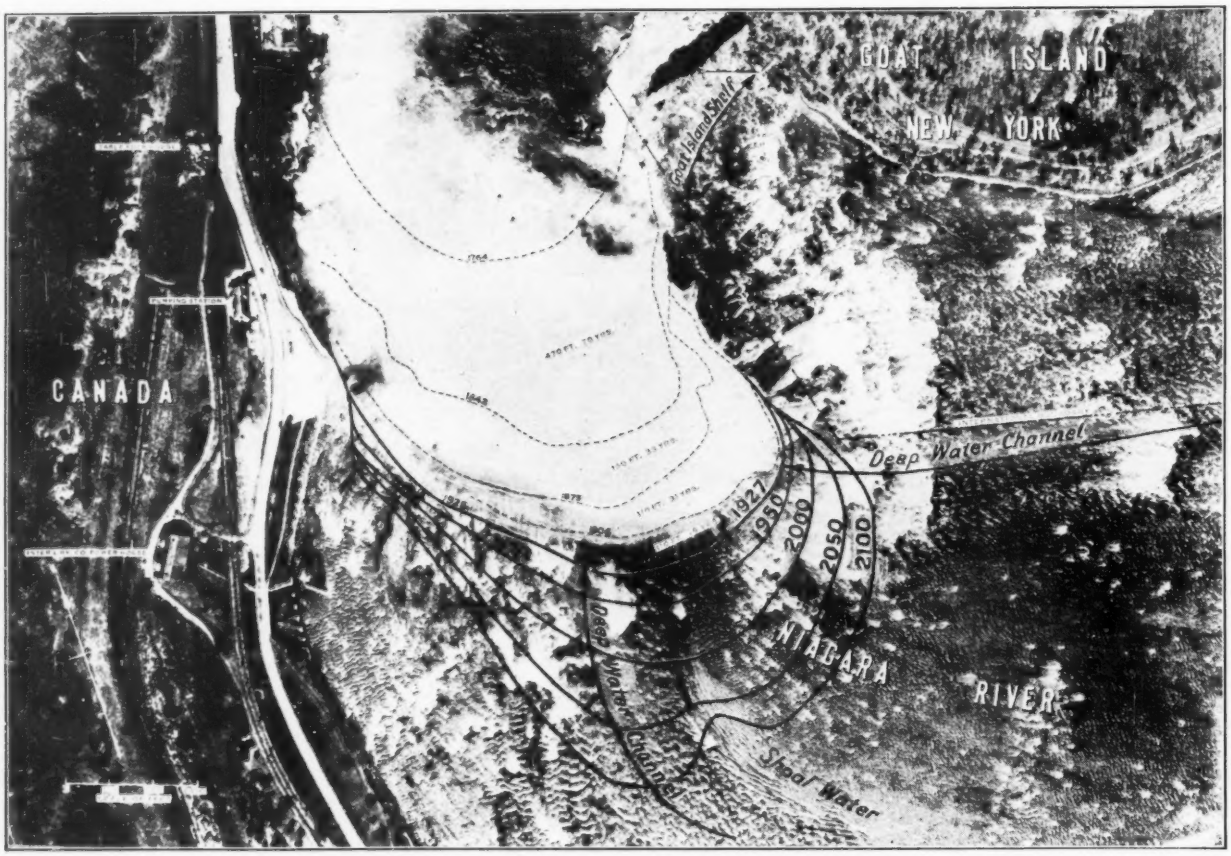
ONE of the longest bridges in the world and one of a chain of three which, with their connecting highways, form a crescent about the upper end of Hampton Roads, a new highway bridge over the James River near Newport News, Virginia, was opened to traffic in November. Governor Byrd officiated at the opening celebration which included a pageant depicting the history of the Old North State.

The new bridge is five and one half miles long, including the approaches, and provides a motor route between Newport News and Norfolk and Portsmouth, thus closing a gap in the Atlantic coastal highway. It is supported by concrete piles weighing up to 35 tons each and 115 feet long. These piles were poured on land, loaded on barges, and towed to the point of operations. There they were placed four abreast, seven feet on centers, and driven two at a time by a gigantic pile driver.

The longest lift span in the world is located about three quarters of the way across this bridge. It is 300 feet long and its lift is 147 feet above mean high water. When the span is in the raised position, the largest vessels in the world can pass underneath.

The floor of this bridge is a concrete surfaced roadway. Motorists who pass over it will, at times, be 50 feet above the water and, on foggy days will be entirely out of sight of land.

The engineering and construction work was carried out by the Turner Construction Company, New York City.



RECESSION OF NIAGARA FALLS—PAST AND FUTURE

Airplane mosaic of the Falls on which previous crest lines have been plotted and future crest lines are predicted. Note how the lip wears away faster at the points where the strongest currents plunge over and how the toe of the Horseshoe will widen, according to geologists

Niagara Should Be Saved

To Preserve Scenic Beauty of the Falls, Simple Remedial Measures Are Recommended by Special Board

IN recent years there has been much agitation for the preservation of Niagara Falls. Some pessimists have pointed to the past record of their rapid recession upstream—about 820 feet since 1764—and have insisted so long and vociferously that the Falls are "committing suicide" that the phrase has become a sort of catchword. Others have traduced the utilitarians for withdrawing water for the generation of power and thus detracting from the natural beauty of the Falls.

Actually, it is true that the Goat Island shelf within the United States boundary line, and the flank of the famous Horseshoe Falls on the Canadian side, are uncovered and practically devoid of water, and it is true, furthermore, that there is but a scant flow over the American Falls. This dewatering is not due so much, however, to the diversion of water for power purposes as it is to the natural recession, or cutting back of the notch, of the Horseshoe Falls. Water withdrawal has, in fact, probably helped to decrease the recession. However, this notch at the toe of the Horseshoe is now receding at a rate of only 2.3 feet per year, contrasted to its rate previous to 1906 of 3.7 feet per year, and is cutting in such a manner as to widen the crest of the toe. This widening will spread the water into a thin sheet and tend to lessen the cutting rate over any unit of the crest.

GEOLOGISTS have shown that the thickness of the upper layer of hard limestone on the floor of the upper rapids increases from 78 feet at the present crest to 130 feet at the head of the upper rapids. Since recession occurs not by wearing at the lip but by undercutting due to the fall of large blocks of stone, this increased thickness will retard recession in years to come. It is therefore highly improbable that the Falls will ever "commit suicide" and become a mere cascade.

It has long been a moot question as to whether the Falls are to be preserved in the full grandeur of their beauty for scenic purposes or further utilized for power generation by the diversion of more water. Either position is extreme and a solution of the problem seems to lie somewhere between these two views. For the purpose of determining what may best be done to preserve the beauty of the Falls and also allow further withdrawal of water, a Special International Niagara Board was created by the United States and Canada to study the situation thoroughly. Its interim report, just completed, recommends initial remedial works that, at reasonable cost, are considered most feasible to effect the desired results.

The Board has tested out on the

small-scale model built by the Niagara Falls Power Company the various types of remedial measures that have been considered. "These demonstrations," to quote the report, "have shown effectively that remedial measures which will improve the scenic value of the Falls are eminently practicable." Furthermore, such works, constructed at comparatively low cost, would make possible a thorough test of the effects of further diversion of water for power generation. If it is possible to withdraw more water from Niagara and, at the same time, have a more beautiful Falls, this would be of vital economic importance. Industrial development in Ontario depends largely on water power and it is claimed on high authority that, already, the power plants on each side of the Falls generate a total of electric power equivalent to 5,000,000 tons of coal yearly.

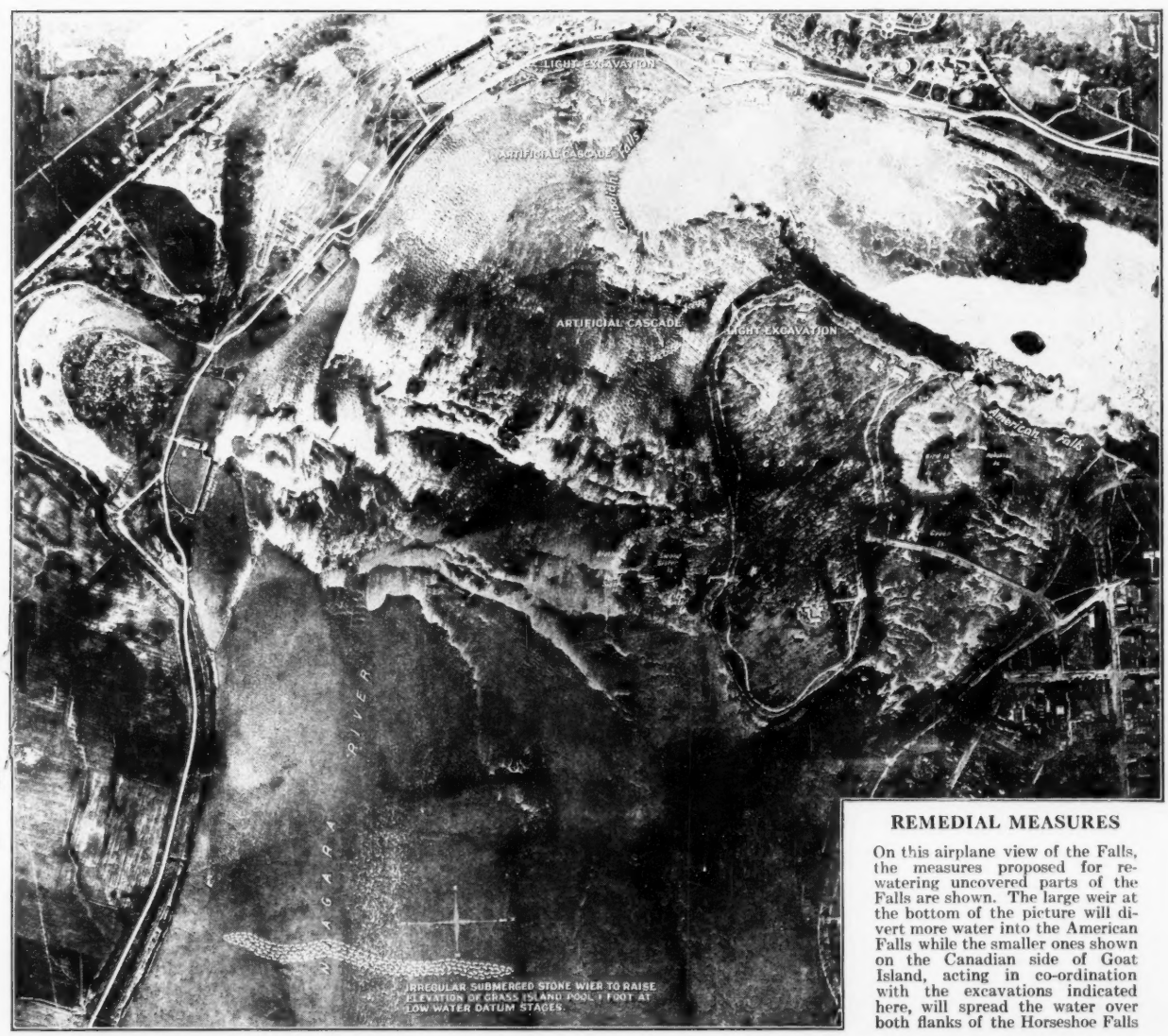
Of the initial works recommended by the Board, the re-watering of the Goat Island shelf is considered of primary importance because this feature is prominent and should carry enough water to bind the Falls into a harmonious whole. Submerged weirs with co-ordinated excavations designed to deflect the water from the central and northern heavy currents will, the Board concludes, distribute the flow over the floor of the shelf and to its crest. Since this work will be submerged to a fair depth, it will not be visible and will cause scarcely a ripple on the surface. Furthermore, it will not deflect enough water from the main crest to thin the water out into a white sheet instead of the green that at present is one feature of its beauty.

THE problem of replenishing the flow over the Canadian flank is not so serious, but the conditions at this point could be improved by the same kind of treatment.

The lack of volume of the American rapids and falls and of the flow around Three Sister Islands can be remedied by raising the level of Grass Island pool approximately one foot at low stages to throw more water against the head of Goat Island. A submerged weir is the logical method of raising this level. It could be of rubble-mound construction; would be quite inconspicuous; and so constructed as to cause no obstruction to the flow of ice.

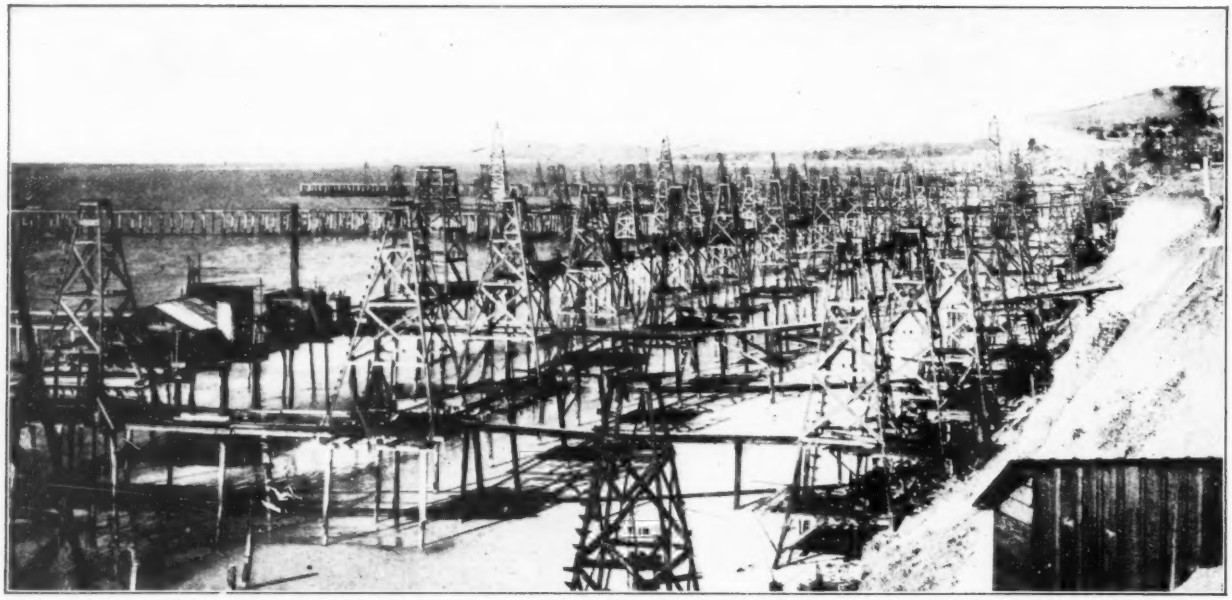
The Interim Report states: "The results to be anticipated from the construction of the works on the two flanks of the Horseshoe Falls will be the insurance at all seasons of an unbroken crest line from shore to shore, the maintenance of the present blended green and white color effects of the Horseshoe Falls, and, in some proportionate measure, a modification of the rate of erosion in the bend. The works in Grass Island pool will ensure an adequate flow in the American rapids and falls and between the Three Sister Islands.

"The Board is of the opinion that the construction of the initial works is highly desirable."


LIGHT EXCAVATION
ARTIFICIAL CASCADE
Canadian Falls
ARTIFICIAL CASCADE
LIGHT EXCAVATION
American Falls
NIAGARA RIVER
IRREGULAR SUBMERGED STONE WIER TO RAISE ELEVATION OF GRASS ISLAND POOL 1 FOOT AT LOW WATER DATUM STAGES.

REMEDIAL MEASURES

On this airplane view of the Falls, the measures proposed for re-watering uncovered parts of the Falls are shown. The large weir at the bottom of the picture will divert more water into the American Falls while the smaller ones shown on the Canadian side of Goat Island, acting in co-ordination with the excavations indicated here, will spread the water over both flanks of the Horseshoe Falls



THE RACE FOR OIL. UNDUE CROWDING OF SEACOAST WELLS IN SOUTHERN CALIFORNIA

The Origin of Petroleum

Modern Scientists Incline Strongly Toward the Theory That Petroleum Is a Product of Once Living Matter

By HEINRICH RIES, Ph.D.
Professor of Geology, Cornell University

IN trying to determine the origin of petroleum, there are several questions which naturally present themselves, such as: 1. Is the petroleum an original substance or was it formed by the breaking down or alteration of some other material? 2. Did it originate in the rocks where it is now found, or if not, what was the source rock? and 3. If it did originate in some other rock, what was the cause or agent of transportation, which made it migrate from the source to its present place of accumulation?

FOR many years there have been two general theories regarding the origin of petroleum, known as the inorganic and the organic. The former states in general that all petroleum is of igneous origin, while the latter postulates that it has been derived by the decomposition of either animal or plant remains.

There is a well defined gap between the advocates of the two theories, and their views are practically irreconcilable. Curiously enough, the believers in the inorganic origin are mostly chemists, while those who have held that the organic origin is the true one are mainly geologists. Let us see just what these two classes of opinion are, and what each has for or against it.

The inorganic theory assumes in general that water or gases contained within the earth, act on certain chemical compounds, as a result of which hydrocarbons are formed. These rise toward the surface and accumulate in favorable spots.

OF the several inorganic theories advanced, that of Mendeléeff, proposed in 1877, will serve as an example. He supposed that iron carbides existed within the earth, and that if underground waters came in contact with these, hydrocarbons would be generated, a reaction that can be produced experimentally in the laboratory.

But while this theory may seem logical at first sight, there is considerable evidence against it. Thus, for example, if petroleum has originated by inorganic processes after the manner outlined, it must be regarded as of direct or indirect igneous origin; and if this is true, then why should we not find it in igneous rocks? There are hundreds of square miles of such rocks exposed on the earth's surface, yet hardly a case of petroleum occurring in them is known, and where any is found, it is in such close proximity to sedimentary rock as to lead us to believe that the oil has migrated from the latter into the former.

Or, to state another objection: Let us suppose for the sake of argument that the oil which is found in sedimentary rocks may have risen upward from underlying igneous ones. The oil may be in sandstones with shales above and below it. It cannot force its way through the overlying shales, and so it is not quite clear how it could have risen through the underlying ones.

One of the most interesting objections, curiously enough, has been supplied by Dr. C. F. Mabery, a chemist, who has pointed out that the nitrogen derivatives, which are formed in most, if not all, petroleums and natural gas, are conclusive evidence against the inorganic origin of these materials, since they can be derived only from matter which is of organic origin.

THE presence of helium has been appealed to by some as an indication of the deep-seated origin of both gas and oil, but little is known regarding the geologic occurrence of this element.

So, on the whole, the inorganic origin has little to recommend it. It may have attracted more attention than it deserves, because its few supporters have argued their cause actively, and very loudly, but no doubt sincerely.

The belief that petroleum is of organic origin was advanced at nearly as early a date as that of inorganic origin, for the well-known geologist J. S. New-

berry in 1873 suggested that oil had come from plant remains which were buried in marine sediments and had after their entombment undergone a process of what he called destructive distillation, as a result of which hydrocarbon compounds were formed.

Practically all geologists and many others are now agreed that both oil and gas have been derived from organic matter, in most cases plants, although a few believe that animal matter made important contributions. This is reasonable when we consider that oil is found almost exclusively in sedimentary rocks, which often contain abundant plant remains in various stages of alteration, and furthermore that certain shales which carry considerable quantities of vegetable matter, will, on heating, yield hydrocarbon compounds similar to those found in oil, and which are liquid at ordinary temperatures. But here comes up another interesting question. Coal is admittedly of vegetable origin, and if we assume that petroleum is also, why was it that in some cases the accumulation of plant remains formed coal, and in others yielded oil?

WHILE we cannot yet answer this question definitely, it is probable that it depends on the composition of the plant debris, conditions of accumulation, and extent to which the plant material has been attacked by bacterial action.

In drawing a comparison between coal and oil, attention should be called to the fact that plant material shows a wide range of character, from the lower forms of plant life, like algae, the tissues of which are of a soft and even gelatinous nature, to higher types which develop woody tissue.

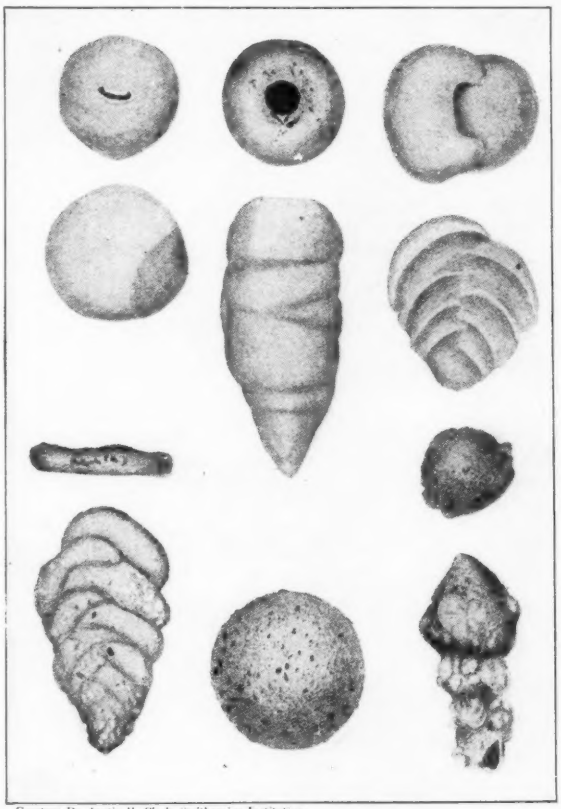
Now in studying coals we find that the identifiable plant remains which are to be found in them are usually of higher types, many of which develop woody tissue. There are, however, certain types of coals like the bog heads and cannels, which show very little woody tissue, but contain great quantities of spores, and remains of algae. The oil shales are similar. These materials all yield oil on heating.

This, then, suggests that some of the lower orders of plants may yield oil on decomposition.

If we look around for present day evidence of this we find that some sea weeds become covered with an oily coating while undergoing decomposition, and that the minute cases of some diatoms which lived by the millions in some bodies of water, are often found to contain globules of oil.

It is a well-known fact that when plant tissue undergoes decomposition under water, it is accompanied by the generation and elimination of by-product gases and some liquid hydrocarbons, the residue left behind being carbonaceous or coaly matter.

Now if we consider different types of plant material, contrasting woody tissue with that which is found in plants like algae, we find that in the case of those deposits of vegetable matter containing a large proportion of the remains of aquatic plants, these latter on dying may accumulate on the bottom forming a slime called *sapropel*. Such slimes or oozes are comparatively rich in hydrogen, and in the buried deposits of them the volatile matter may exceed 85 percent of the combustible matter.



Courtesy Dr. Austin H. Clark, Smithsonian Institution

TYPES OF FORAMINIFERA

For diagnostic purposes these minute shells are of great importance in oil bearing deposits. The oil geologists now study them almost as closely as do the marine biologists

This leads, then, to the belief that the sapropelic sediments are to be regarded as the effective "mother rocks" or "source beds" of petroleum.

What actually takes place has been well summarized by Dr. David White who suggests that the petroleum has been derived mostly from plants of low orders that yield waxy, fatty, gelatinous, or resinous products, mixed with which there may be more or less animal matter; and as will be mentioned later some believe the latter is an important source.

This organic matter may be deposited as organic detritus in muds or slimes, in both fresh or salt water. After aerobic bacteria had ceased to act on it, it was probably long subjected to slow deoxidation by anaerobic ones. The work of the latter results in the liberation of the hydrocarbon compound marsh gas or methane, which is the chief constituent of natural gas, and a common, although not large, constituent of petroleum.

The first part of the change may go on while the sapropelic material is accumulating on the bottom of the body of water and is called the bio-chemical stage. Later on when these slimes become buried under other sediments, the process continues during what is known as the dynamo-chemical stage.

The question may be raised, why any oil globules as soon as formed in the slime do not rise to the surface and float. The point is that oil globules do not tend to float in turbid water, but are drawn down by clayey sediment and held there.

BEFORE carrying this discussion further, we may attempt to decide whether, if plants are the source material of oil (and gas), they were of marine or land types.

The argument in favor of land and fresh water types may seem to be the logical and stronger one, because land plants were probably much more abundant than marine forms. Then, too, the rock forming the source beds often gives evidence of having been formed in fresh water or, if not, in shallow water close to the shore.

It seems probable, however, according to Dr. White, that oils originating in fresh water or marine deposits do not differ much as to volume or quantity, but fresh-water deposits are thought by some to be purer, richer, and more widespread, although others hold to the view that the salinity of the water is essential to oil generation.

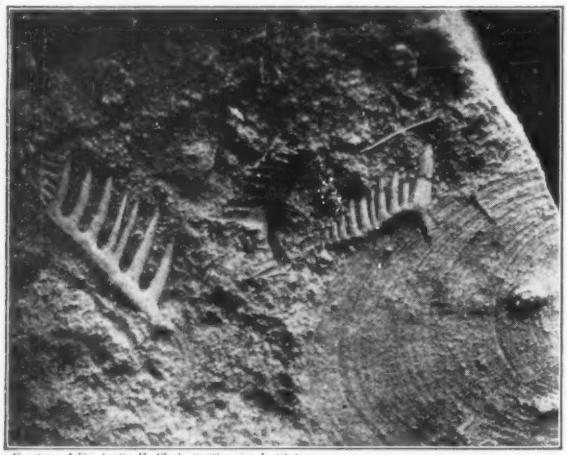
The importance of animals as source materials of oil is of problematic value even though the work of Engler, Hofer, and others has shown that it is possible to extract hydrocarbons from dead fish and other animal remains.

The objections offered to animals as a source material are that their soft parts are rarely buried in muds, and if they were entombed in sufficient quantity to form much oil, that the latter should show appreciable amounts of

phosphate of lime, which is contained in animal tissue.

On the whole, then, animal tissue probably contributes little in most cases, and so we turn to plants as the chief source of oil.

Given, then, the proper type of vegetable matter, accumulated and decayed under the conditions previously outlined, it seems evident that petroleum may form in sedimentary deposits, and that such rocks may also contain some carbonaceous matter.



Courtesy of Dr. Austin H. Clark, Smithsonian Institution

SUGGESTING ONE SOURCE OF OIL

Conodonts, usually held to be the teeth of small fossil fishes. From the black oil bearing shales of the Carboniferous Period

This rock, which may be called the source rock, is usually fine grained, and represents a type often found associated with the petroleum bearing rocks. It is not generally believed, however, that source beds form the reservoir rock of commercial oil pools, but that the oil has migrated from the former into the latter.

An important problem which has presented itself is the character of the original material in the source beds—that is, whether it was buried liquid oil, or a semi-solid wax which after burial was acted on by natural agencies and broken up to yield liquid petroleum.

THIS question has been brought up by the fact that in some rocks such as oil shales, no liquid oil is yielded to the well, but can be obtained by distillation, whereas in other source beds liquid petroleum is undoubtedly present.

It is difficult to conceive that enough heat was developed to distil the petroleum out of the source rock, as about 450 degrees, Fahrenheit, is required to accomplish this.

Pressure has been appealed to as a possible agent, but experiments along this line have not yielded very satisfactory results, although a slight quantity of soluble hydrocarbons can be developed in this manner or even by grinding.

A theory put forward by McCoy is, that while liquid petroleum may form in marine or brackish water oozes, it becomes wax-like as consolidation proceeds, through gases and connate waters, that is, those indigenous in the rocks, acting on it. If, however, before this occurs, structural conditions develop in the rock which will permit the oil to migrate into and accumulate in the reservoir rock, it will remain in a liquid condition.

If, then, no movements of the rock occurred before consolidation, the bituminous matter would all remain in the source bed. This is an hypothesis which still remains to be proved.

Since it is pretty generally accepted that the liquid petroleum migrates from the source rock into the reservoir rock where it accumulates, we may inquire what agents assist in this process. Among those which suggest themselves are heat, pressure, and water.

Heat hardly seems a competent agent, since in petroleum bearing strata the temperature, as a rule, is not very high.

Pressure may appeal to us if we think of the source rock as a compressible stratum, from which oil might be forced into less compressible and porous beds, but two difficulties present themselves at once. The first is that the mud forming the source bed may have been so compacted during settling and consolidation that it is not capable of much more compaction. The second is that if the pores of the reservoir rock are already filled with water, it is difficult to see how this could be compressed enough to make room for the oil being forced into it.

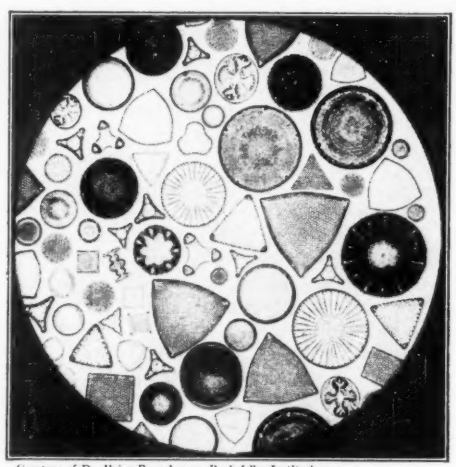
EXPERIMENTS made to throw light on the last named point have not been attended with much success.

The third agent, water, is more promising, but might be capable of acting in one of two ways. One theory assumes that the oil has been carried by moving water from the source bed into the reservoir rock. If such were the case, however, it would require the water to move from points of higher pressure, to others of lower pressure, passing across or through the source beds; but this assumption does not conform to the field evidence, because the source beds, owing to their fine texture, would not be very permeable, and moreover the different composition of the water often found in neighboring strata, is clearly against any such general circulation.

Any circulation due to gravitation also seems to be precluded because of the small size of the rock pores, especially those of the source beds, which may be .01 millimeter (one 2500th inch) or less.

A SECOND view, and one which seems to have much to recommend it, is based on the belief that migration of the oil is brought about by an interchange of oil and water, due to the physical properties of the two.

This can be illustrated by having a layer of oil-soaked shale next to a water-soaked sand. Under such conditions we find that the water migrates into the shale, and the oil into the sand, a phenomenon which can be demonstrated experimentally. The interchange is commonly explained as being due to the greater adhesion of the water for the shale particles. The water, therefore, draws itself into the finer pores of the latter, thus evicting the oil. The oil apparently breaks up into very small drops which migrate back through the water passages, until the material reaches a state of equilibrium in the sandstone. It is assumed that the source beds would have to be fairly well saturated with oil to make the process of interchange effective.



Courtesy of Dr. Heinz Rosenberger, Rockefeller Institution

DIATOM SKELETONS

It was a long way from practical oil prospecting to the study of marine biology—until the connection was seen by the practical prospector

The oil, having entered the reservoir rock, some means must be at hand to concentrate it in "pools," as these accumulations of oil in porous rocks are called.

The original idea was that gravitative processes were responsible for the concentration of oil in pools, and this

was developed to explain the original anticlinal theory of oil and gas accumulation. According to this, oil and gas were to be looked for in arch-like folds of porous rock, capped by a denser stratum. The gas, because of its lighter specific gravity, was thought to collect at the top of the arch, the oil below it on the flanks, and saline water, if present, farther down still. In other words it appeared as if these three materials would sort themselves gravitationally, moving up a bed until they met with some obstruction.

IT is true that this principle seems to have much to commend it, and we find that where they occur in porous beds, both oil and gas appear to be closely associated with arch-like folds in the rocks. Indeed, this fact is, in general, made wide use of in the world-wide search for new oil formations, which is now going on. At the same time, experiments indicate that this gravitational separation does not take place by any means freely, very fine sands tending to impede greatly if not prevent it altogether. It does appear, however, that if gas is present below the oil and water it seems to assist the sorting process.

The other way in which water may assist in the accumulation of oil, is according to what is known as the hydraulic theory. This view holds that circulating waters moving through the reservoir rock might carry small particles of oil in currents, until it reaches some eddy caused by structural conditions of the rock. Here it remains protected, while other oil particles join it until a pool is formed. The process may no doubt operate under favorable conditions. The objection which has been urged against the hydraulic theory is that there must be some place for the water to go, otherwise there would appear to be little possibility of any circulation.

Another possible explanation of the migration of oil in reservoir rock is gas pressure, for it is well known that gas is dissolved and occluded to a great extent in petroleum. As this gas tends to exert an expansive force, it is quite possible that it may assist the movement of the oil through the pores of the rock. It is certainly responsible for the uprush of oil through the drill hole.

There seems no doubt that even after petroleum has been formed in sediments, it may undergo a progressive change due to continued pressure and heat to which it may be exposed, just as is the case with coal. When peat, the mother substance of coal, is buried in the sedimentary rocks, it changes progressively to lignite, bituminous coal, and anthracite, which is represented by an increase in the carbon content, and a decrease in the more volatile constituents like hydrogen and oxygen. If, then, petroleum is buried in the same series of rocks, it too undergoes a change.

THAT there is some such relation has been brought out in a most interesting way by Dr. White, who showed that where the coals were of the rank of brown lignites, the oils were heavy, with a gravity on the Baumé scale of 20 degrees to 26 degrees, and that if the vegetable matter had been transformed to bituminous rank, the oils have in general attained a Baumé gravity of 35 degrees or more.

Where, however, the change of the coal has progressed to such a degree as to pass a fixed carbon content of 65 percent, figured on a pure coal basis, the oils which may have formerly been present in the same or underlying formations have mostly disappeared, although gas may be present.

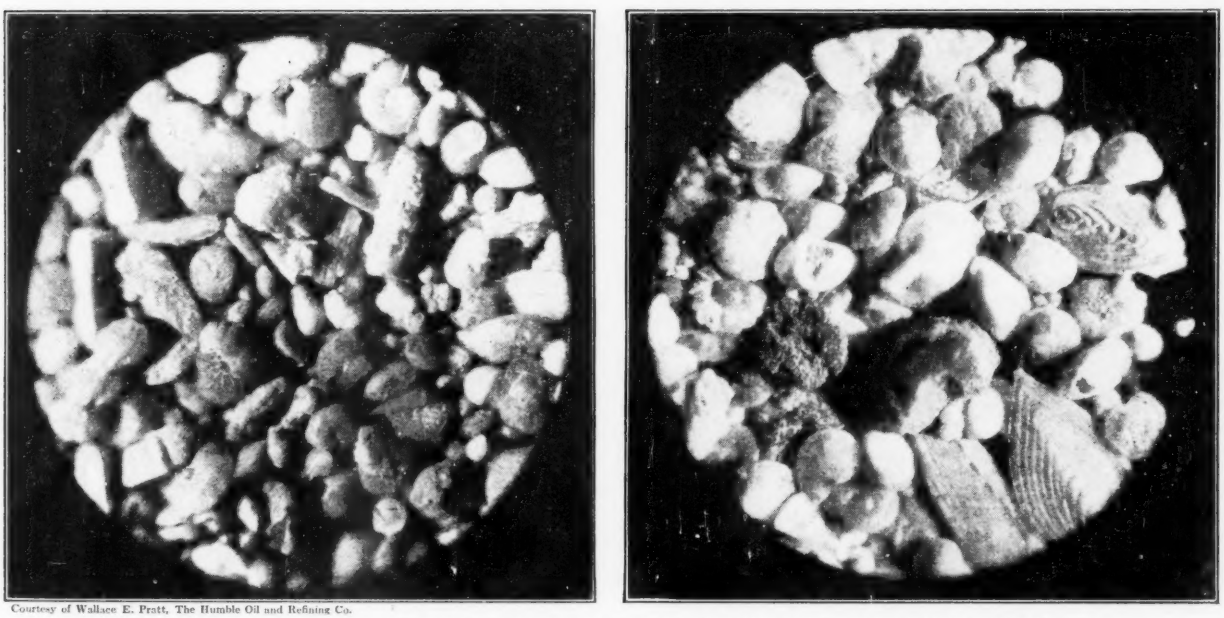
ASIDE from this cause of variation in the rank of oil, it seems possible that filtration through the porous rocks may bring about a fractional separation of the original oil, and possibly explain the occurrence of some very light ones.

The petroleum having become concentrated in the pores or other spaces to form a *pool*, as it is called, remains there until tapped by the drill. These pools are found at depths ranging from 100 feet to over 6000 feet.

In conclusion, it may be said that it is now pretty generally believed that oil and natural gas are of organic origin, having originated by the accumulation and decay, chiefly of low orders of plants and possibly to a lesser extent of animal remains in sedimentary muds of either fresh water or marine origin.

It is also widely believed that the hydrocarbons so formed have later migrated from their source beds into the reservoir rock, where they have accumulated to form pools, which are often associated with arch-like structures of the beds.

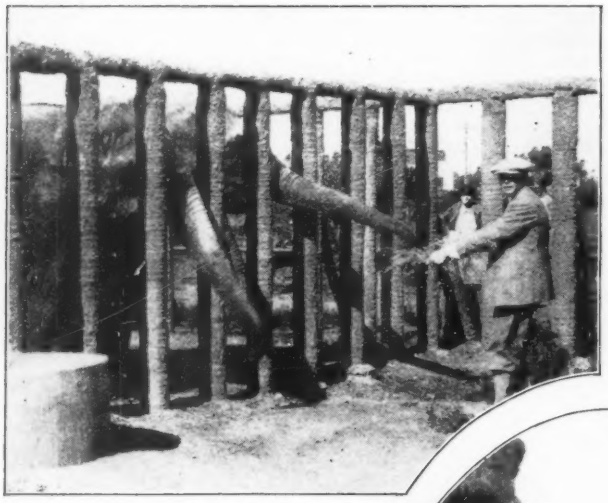
The rather wide geologic distribution of these oil pools in sedimentary rocks ranging from Ordovician to Tertiary in geologic age indicates that conditions favorable for oil formation recurred a number of times in the geologic past.



Courtesy of Wallace E. Pratt, The Humble Oil and Refining Co.

FORAMINIFERA FROM DRILL CUTTINGS FROM PETROUS OIL WELLS (MAGNIFIED)

Petroleum geologists now make the same use of these evidences that coal geologists make of plant fossils in correlating coal measures



A "CAGELESS CAGE"

Even the elephants are made to feel as much at home as possible. The enclosures which confine them are so constructed that they retain the animals, yet give a sense of freedom because of the way in which the bars are made to resemble tree trunks. Thus, visitors see the animals as if in their native haunts

BIRD CAGE

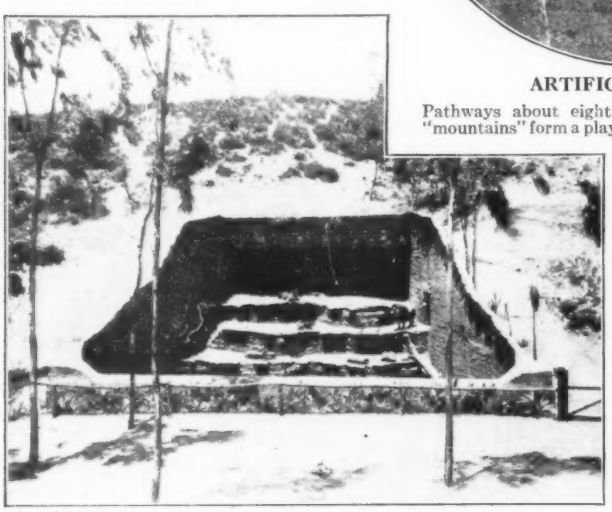
What is said to be the world's largest cage for flying birds is illustrated above. Many of the larger species of birds are safely housed in this wire-covered cage, yet are provided with plenty of room for exercise. To gain an idea of the immense size of this unique aviary compare it with the two men seen standing on the steps

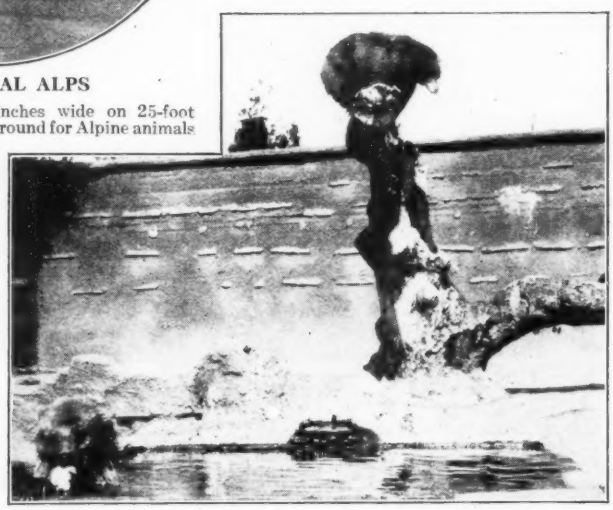
THE LIONS' DEN

In the San Diego Zoological Gardens, the King of Beasts is provided with a den which keeps him in his place, but allows him to wander at will. Between the den and the visitors' path there is a deep, wide moat studded with spikes, making it impossible for the animals to escape, yet not distracting from the novel effect

BRUIN'S GROTTO

Large excavations provided with swimming pools, tree trunks, and other luxuries dear to the heart of members of the ursine family keep the bears in a contented condition and allow them to disport themselves to their utmost content, at the same time providing amusement and instruction for visitors





ARTIFICIAL ALPS

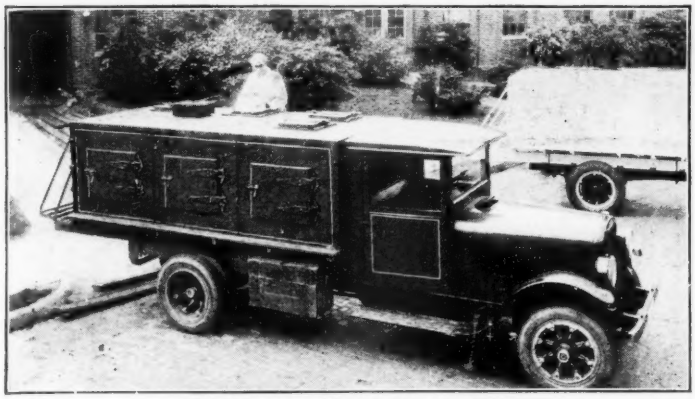
Pathways about eight inches wide on 25-foot "mountains" form a playground for Alpine animals

Futurial California

Contented Animals Have a Home-like Zoo

IN San Diego, California, there is a zoo that is unique among all of the zoos of the world. Rated as the fourth largest in the United States and second in variety of specimens, this educational collection of animals is kept in captivity with a minimum of cages and bars. Favored by climate, which is mild the year around, there is no necessity of housing the animals within walls where they must be provided with heat in winter and cool breezes in summer. They may be kept out of doors all year long, subject to even less discomfort than they were accustomed to in wild life. Furthermore, the confining structures of the zoo are so made that visitors viewing the animals feel that they are seeing them in their natural haunts. The location of the zoo was a happy selection, as existing valleys allowed the construction of pits and grottos with a minimum of labor. These depressions serve to confine the animals without the use of bars, and allow them a pseudo freedom that is conducive to well-being. The moving spirit of the zoo is Dr. Harry M. Wegeforth, who has built up the exhibits by careful trading with other zoos. Scores of individuals and business firms have contributed for establishing specific cages or exhibits.

Of Interest to Motorists

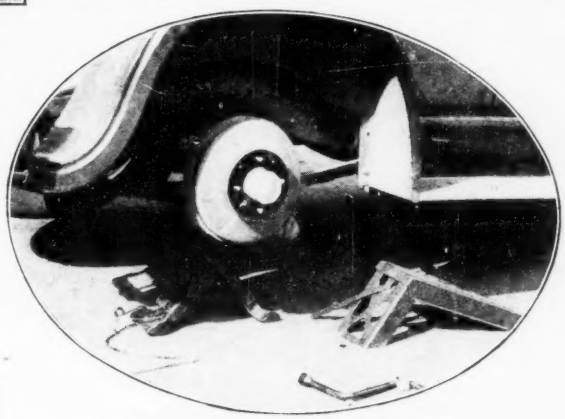


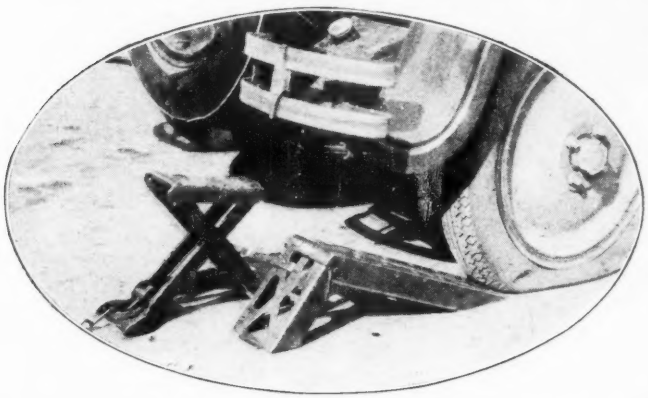
ICE CREAM DELIVERY TRUCK

This new refrigerator truck uses as a refrigerant solidified carbon dioxide gas, the snowy, extremely cold substance called dry ice, a small piece of which replaces several hundred pounds of ordinary ice and salt. The body walls are insulated with cork board and balsa wood. As the dry ice evaporates, the gas circulates as a cold blanket around the outside of the tanks in which the ice cream cans are placed.—*Fitz Gibbon and Crisp, Inc., Trenton, New Jersey*

FENDER REPAIRER

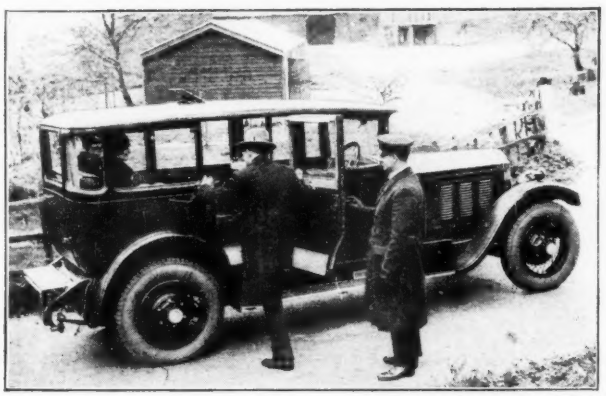
It often happens that the family car is rammed by another or meets with a minor accident that causes bent fenders. This tool has been designed to enable the owner to straighten fenders with minimum labor. It is a heavy, forged bar with a closely bent hook at one end and a pad and hook at the other.—*Kent Moore Organization, General Motors Bldg., Detroit*

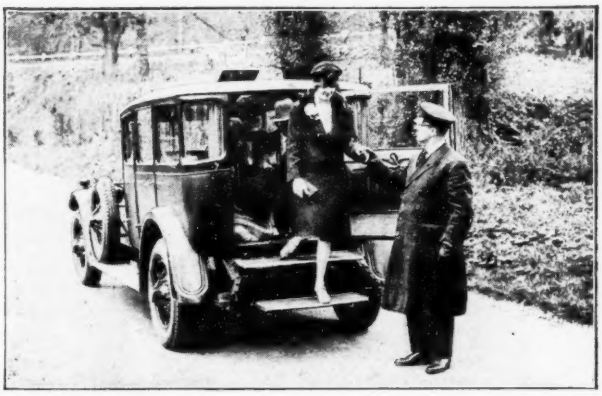




ROLL-UPON AUTOMOBILE JACK

Although not exactly a jack since the car does the work, this device consists of an inclined runway and a table, all parts of which are of strong light-weight steel. When the car is driven up the incline to the peak, it drops over on the table. The table collapses when the chain is pulled. It folds compactly to go under the car seat. —*Applied Management, Inc., Mitten Bldg., Philadelphia*

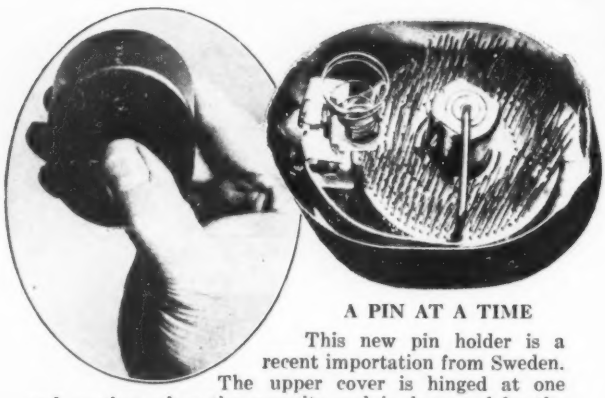




OBSERVATION BODY FOR AUTOMOBILES

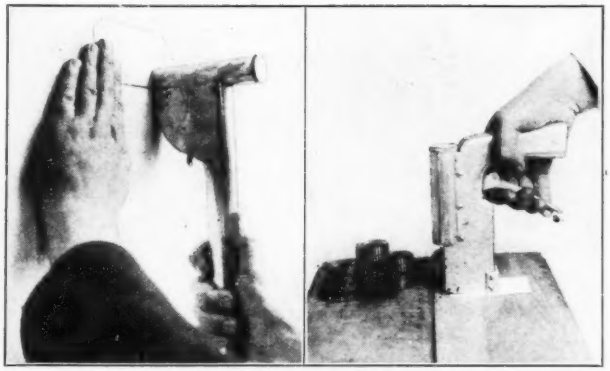
Reminiscent of the early American cars which were entered from the rear, and yet entirely novel, this new body manufactured in England was designed to enable passengers to arrange seats in the tonneau to suit the occasion and give a clear view in any direction at any time. The seats may face forward or they may be turned to face the rear. In the first case, the side door is to be used for entering or leaving the car; and in the second case, the rear door is used. The arrangement is said to be especially convenient when passengers wish to view the country through which they are passing, without the nervousness usually induced by watching oncoming traffic. This odd new observation saloon body can be fitted to any suitable chassis.—*Evans, Kip, and Hackett, Inc.,* 389 *Fourth Ave., New York*

Inventions New and Interesting



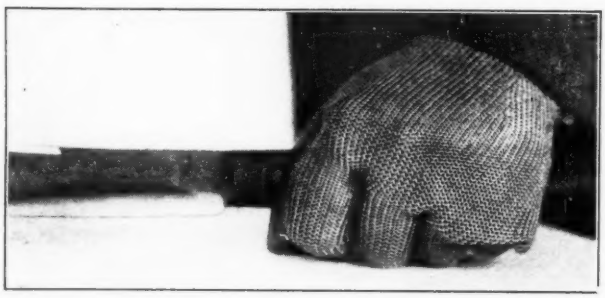
A PIN AT A TIME

This new pin holder is a recent importation from Sweden. The upper cover is hinged at one end so that when the opposite end is depressed by the fingers, one pin is pushed out, head first, through a small hole. At the right is the ingenious concealed mechanism. *—Square Deal Supply Company, 246 Fifth Ave., New York*



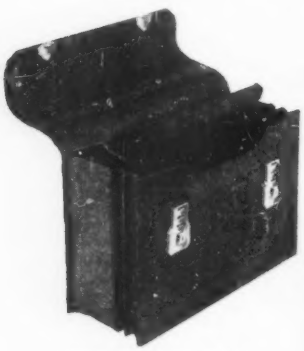
RAPID STAPLERS

These machines are operated by triggers and have a capacity of from 100 to 1000 staples without reloading. They are used in attaching shipping tags and routing cards to freight cars and for tacking upholstery material. The staples are cut, formed, and driven by the machine. *—C. A. Palmgren, Jr., 8389 Chicago Ave., Chicago*



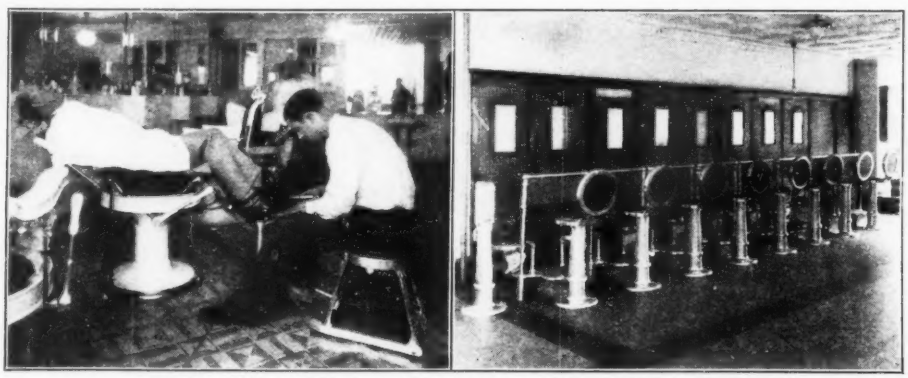
BUTCHER'S GLOVE ➤

A physician who had to treat many cut hands each day invented this glove of woven steel links for butchers.—*Armour and Co., Union Stock Yards, South St. Paul, Minnesota*



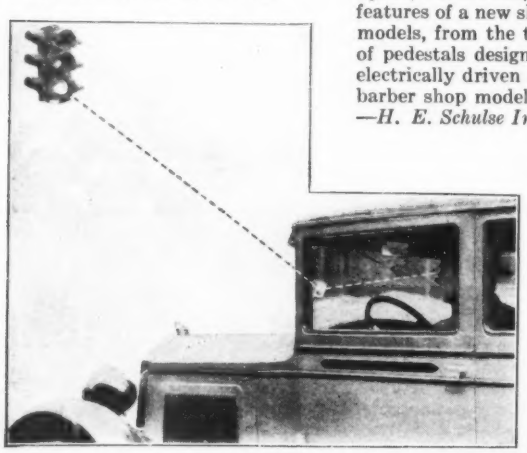
BRIEF CASE BAG

With this dual-purpose bag, a man can make a short business trip without excess luggage. Several compartments are provided for papers, et cetera; and a larger one, with a separate flap cover, is provided for extra laundry. — *National Brief Case Mfg. Co., 500 S. Peoria St., Chicago*



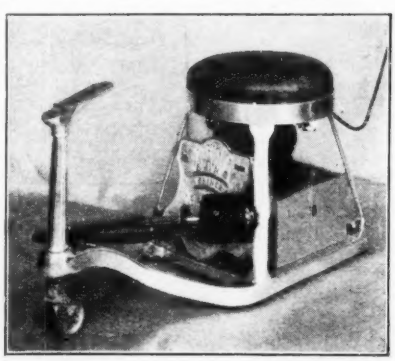
SEMI-AUTOMATIC ELECTRICAL SHOE SHINING MACHINE

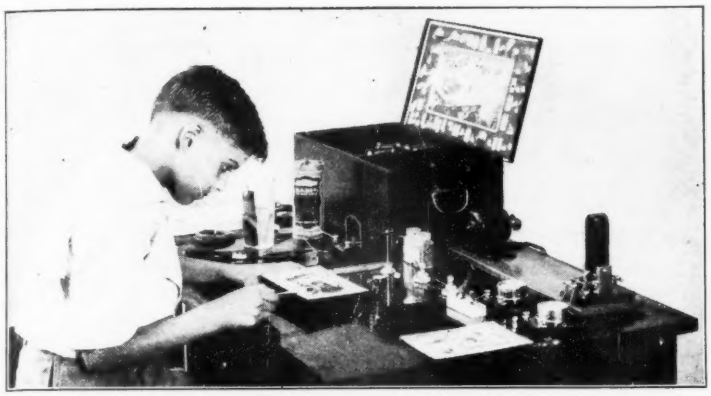
Speed, cleanliness, the comfort of patrons, durability, and economy are the outstanding features of a new shining apparatus invented by a New York man. It is made up in several models, from the type to be used in a shoe store, repair shop, barber shop, to the battery of pedestals designed for large establisments. Speed and cleanliness are achieved by the electrically driven polisher which has a rotary brush. *Above at left and below at right:* the barber shop model; *above, at right:* chair model. *—H. E. Schulse Inc., 248 W. 14th St., New York*



◄TRAFFIC SIGNAL PRISM

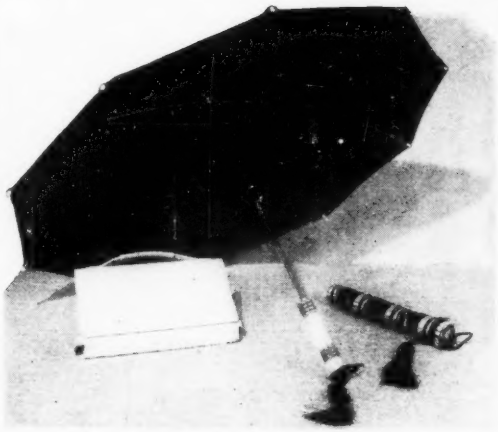
To allow the driver of a car to watch the change of overhead traffic signals without craning his neck, this device has been invented. It consists of a prism, one face of which is raised like a convex lens, to be attached to the windshield. It deflects the light rays.—*Wilcox Specialty Co., Film Exchange Bldg., Cleveland, Ohio*





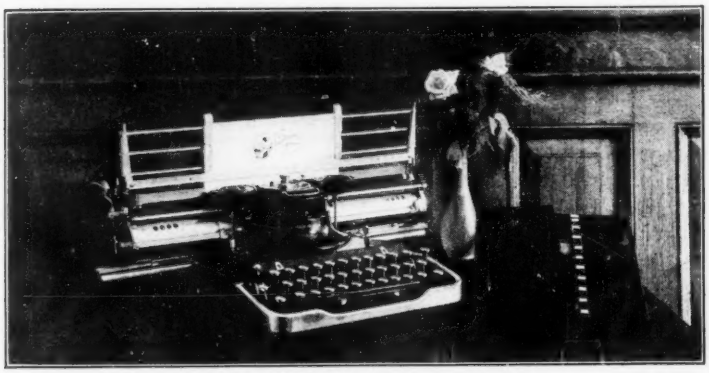
BOY'S ELECTRICAL LABORATORY

Built for boys from eight to 18 years of age, this laboratory is both educational and entertaining. The strong steel chest contains a motor, generator, ammeter, voltmeter, galvanometer, magnets, telegraph set, and other devices necessary to carry on a great number of experiments.—*Interstate Electrical Co., St. Louis, Missouri*



POCKET-SIZE UMBRELLA

This new folding umbrella, an open and a closed model of which are shown here, folds into such an attractive compact roll that it can actually be carried in the under-arm bag, in the pocket or on the arm.—*C. Berwin Co., 320 Fifth Ave., New York*

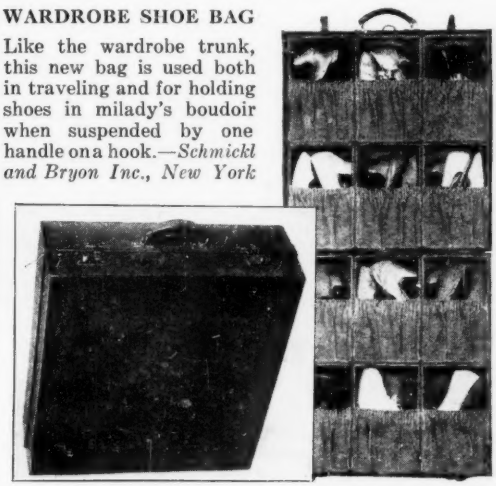


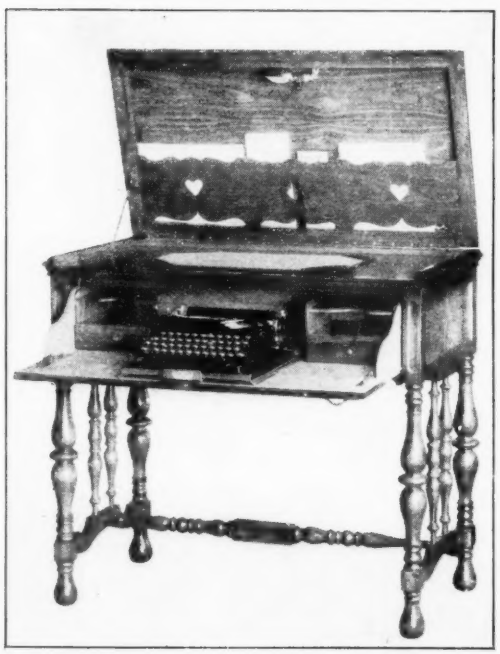
MANY-LANGUAGE TYPEWRITER

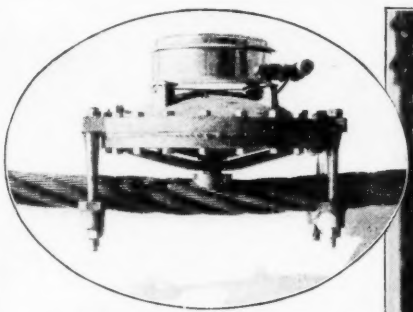
This new typewriter can be changed instantly to write any one of a large number of foreign languages with proper type and accent marks, or to write the Roman alphabet in a variety of individualistic or business styles. Alphabets for languages or styles are concentrated on semicircular plates which may be attached or removed from the machine by the turn of a knob.—*Varityper Inc., 305 Broadway, New York*

WARDROBE SHOE BAG

Like the wardrobe trunk, this new bag is used both in traveling and for holding shoes in milady's boudoir when suspended by one handle on a hook.—*Schmickl and Bryon Inc., New York*

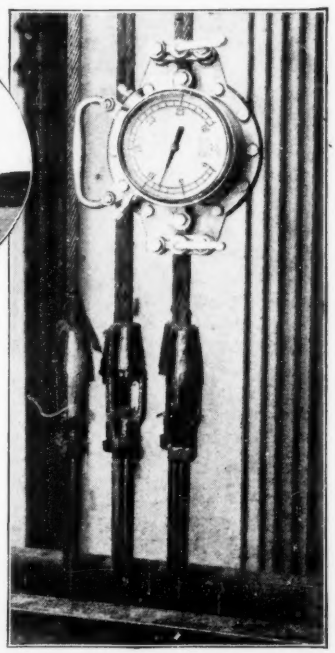






CABLE TENSION METER ▲ ➤

Above and at the right are shown a new meter which can be attached to a cable, guy line, or wire for determining the tension. Cutting of cable is unnecessary. —*Martin-Loomis Corporation, 568 E. Willow St., Long Beach, California*



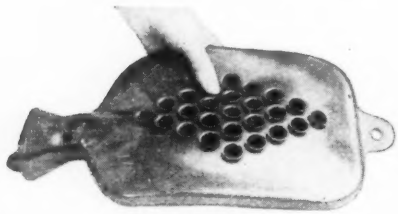
◄ HOME TYPEWRITER DESK

An engineer and a furniture manufacturer got together and designed the desk shown here which has compartments for a portable typewriter, stationery, et cetera. Closed, it is a library table. —*Wil-Fre-Co., 2501 Homer St., Chicago*

Inventions for the Household

DRESS ENVELOPE

This covering for men's or women's garments preserves them when packed away, and also provides a hanger which can be used without disturbing the clothing within. Envelopes are equally useful at home or when traveling.—*General Appliance Corp., San Francisco, California*



IT STAYS PUT

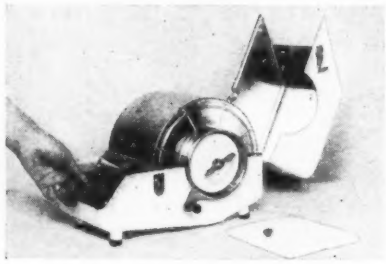
It is often found difficult to keep the ordinary hot-water bottle in place. This new type, however, is equipped with vacuum cups which hold it securely, regardless of position, and prevent it from slipping.—*Daniel E. Lutz Company, Buffalo, New York*

BATH SAFETY

Statistics show graphically how many people are injured by falls in bath tubs. This mat, held in place by vacuum cups, will tend to reduce this hazard, as it presents a firm, perfectly safe footing to wet, slippery feet.—*Safe-Bath Company, 4924 Sheridan Road, Chicago, Illinois*

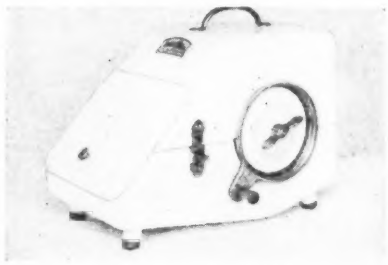
EGG KETTLE

Put the eggs in this kettle, cover with cold water, put kettle on the fire, and go about getting the rest of the meal. When the whistle sounds, remove eggs. They are done right.—*The U. S. Manufacturing Company, 123 Clovelly Road, Stamford, Connecticut*



HANGER-BRUSH

This folding clothes hanger serves two purposes. It is, first, a hanger, and second, an efficient clothes brush. The folding feature makes it desirable for traveling.—*Avery Manufacturing Company, 244 Long Lane, Tower Bridge Rd., London, SE1, Eng.*

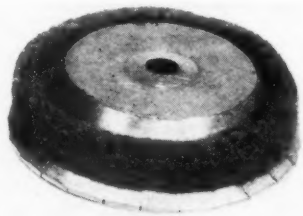


QUICK ICE CREAM

Ice and salt are placed in the cylinder. Liquid to be frozen is placed in the trough. As the cylinder is revolved, the liquid freezes on the outside of it, and the frozen delicacy is scraped off into a waiting tray.—*Instant Freezer Corporation, Racine, Wisconsin.*

BOTTLE HOLDER

This milk bottle holder may be fastened wherever convenient. It folds out of the way when not in use. —*S. S. Kresge Company, Chicago*



BUG BARRIER

When beds, refrigerators, et cetera, are equipped with these felt pads saturated with bug-repelling liquid and placed over the castors, they are kept free from insects.—*Wm. B. Ramsey, P. O. Box 487, Atlanta, Ga.*

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

A Pleasure-Car Snow-Plow

MOTORISTS who live in suburban towns and have their garages located in alleys or at the ends of long driveways; on private lanes; or in the country, usually have much trouble, when winter comes, in clearing away the snow for more easily driving their cars. To these, a simple snow-plow that can be attached to their pleasure cars should be a boon. Such a plow has been invented and patented by Mr. E. B. Meyer of Newburgh, New York, whose father, strangely enough, years ago took out patents on a quickly detachable overshoe for horses, designed to prevent them from slipping on the ice.

The plow is constructed of heavy gage sheet steel and weighs a little over 200 pounds. Most of the weight is carried on a specially-constructed self-steering runner which holds the plow off the ground. The whole device is attached to the car by means of axle clamps which remain on the car the year 'round. The plow is connected in a few minutes by inserting two hinge bolts and it is easily handled by one man.

Cage Experiment Proves Borer Can be Controlled

MORE than a million square feet of copper screening were used in the construction of two gigantic cages which experts of the United States Bureau of Entomology employed in a unique experiment to determine the effectiveness of methods recommended for controlling the destructive corn borer.

The cages were built under the supervision of Dr. W. H. Larrimer on a farm maintained by the bureau in a heavily infested region near Toledo, Ohio. Each cage was nine feet high and covered an acre of corn, planted after the soil had been treated to destroy the larvae.

As the moths appeared they collected on the top and sides of the cage, from which they were painstakingly gathered with butterfly nets. An actual count was made of the number which emerged and this count, which has just been completed, reveals that control methods developed by the bureau are more than 98 percent effective. As a result, the Department of Agriculture will redouble its efforts to persuade farmers to use these methods in the American corn belt.

From 25 to 40 percent of each season's corn crop is frequently destroyed in regions infested by this dangerous pest, which, since its discovery near Boston in 1917, has spread over approximately 100,000 acres of corn country. In Ontario, Canada, destruction has reached a record high of between 75 and 80 percent of the crop.

The 200-pound snow plow which is easily attached to a passenger car

Entomologists are convinced that it will be impossible to eradicate the corn borer but the recent experiment indicates that it can be controlled sufficiently to reduce commercial losses to a negligible amount. Plowing under infested stalks and stubble so that no plant remnants, harboring the worms, remain on the soil surface, is an effective control. Burning over the fields is another effective mode of combat. Special burning machines, which use oil as fuel and produce heat and flames reaching a temperature of 1400 degrees, Fahrenheit, have been developed for this purpose.

—*Science Service.*

Metering a Car's Behavior

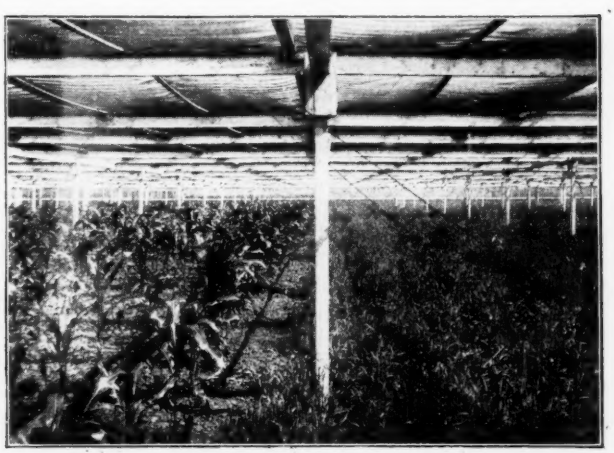
MEASURING the pulling power of an automobile by the swing of a magnetically balanced pendulum is now possible with a device called the performance meter. The makers of this self-contained instrument offer it as a means of accurately rating the pounds-pull of a new or used car, of determining the car's percentage of efficiency, and of checking loss of power due to excessive carbon in the motor, frictional losses, or improper carburetion.

The pendulum consists of a powerful permanent magnet suspended to take a normally vertical position. It thus utilizes the principle of the plumb bob, but is controlled by a damping fluid in a hermetically sealed box. With this control it achieves sufficient stability to resist jars and sudden shocks that would make its movements erratic.

The meter is solidly and attractively built and equipped with a universal connection for mounting at any angle on the dash or the steering post of a car. In either of these positions, the scale on the periphery of the rotating element is visible to the driver. On the left side of this element the scale is marked in pounds-per-ton pull, while the other is marked in percentage gradient. It may be used for determing the acceleration or deceleration of a car, may be made to show friction and power losses of the motor, and to determine

Courtesy Bureau of Entomology

The two cages, seen in the distance, which were built to determine the effectiveness of methods of control of corn borer. The ground covered was previously treated



Under the protection of one of the acre-large cages, where moths were caught as fast as they grew to maturity and compared with those from untreated ground

the steepness of a grade on which a car is running.

In determining the maximum pulling power of a car, the meter is adjusted by means of a worm screw to a zero reading. Then the car is driven up any hill sufficiently steep to give low speed in high

Installed on steering column, the performance meter is always visible

gear. The maximum pounds-per-ton pull is then read on the meter just before a change of gear is necessary. This gives a definite standard of rating on which to compare the performance of your car later.

The maximum pounds-pull is usually shown at a speed of about 20 miles per hour, and it is often more convenient to use the pulling power of a car at 30 miles per hour as a basis of comparison. This may be obtained by driving the car on a slight up-grade at about 10 miles per hour and then depressing the accelerator fully. Maximum acceleration may then be read directly from the meter some time before the car reaches a speed of 30 miles per hour. Acceleration, while the carburetor, timing gears, or other parts of the motor are being adjusted, compared with the original maximum reading, will show a variation from normal and indicate perfect adjustment or the necessity for further adjustment.

In using the gradient scale, the meter, of course, must be set at zero while the car is standing. Then when the car is driven up a hill at constant speed, the percentage of grade may be read directly from the meter.

This performance meter which has been called the physician of the motor car since it will diagnose common motor troubles, is an English product and is being introduced in this country by E. C. Cheswell of Melrose Highlands, Massachusetts.

Machine Gun and Crew Dropped from Airplane by Parachute

ACCORDING to a report emanating from the War Department, airplanes have found a new field of usefulness. The report states that, in a demonstration at Brooks Field, Texas, recently, machine gunners together with their gun, dropped from an airplane and, on landing, went into action in less than three minutes.

In the demonstration, six men jumped from a bombing plane, each with his individual parachute, picked up the machine gun which had also been dropped on a parachute, set it up, and started firing.

In this manner it is possible that a number of guns and their crews could be dropped and placed in action in commanding positions. The value of this maneuver in warfare would lie in the large element of surprise it contains. Its strategic value may prove to be very great.

Self Lubricating Spring

MOTORISTS and automotive engineers have long been seeking to improve the method of lubricating springs. Because of the comparative inaccessibility of automobile springs, they are frequently neglected. Dust, dirt, and water work into the springs, making frequent and efficient lubrication necessary if the springs are to be kept from being virtually welded together, nullifying the advantage of laminated spring construction.

New springs ride easily because they are greased with graphite before they are assembled. But when the lubricant dries out, the springs rust and lose their flexibility, eventually crystalizing to such a degree that any severe jolt may break them.

Another type of mounting for the performance meter, for installation on the dash of an automobile

To counteract this tendency and to make the necessary lubrication so easy that there will be no cause for neglecting the springs, a self-lubricating spring has been designed by the Triple Action Spring Company.

Slots one quarter of an inch wide and two inches long, overlapping one quarter of an inch with slots in adjacent leaves, provide a channel for the grease to be distributed across the face of each leaf by capillary attraction and the flexing of the leaves.

By means of Dot, Zerk, or Alemite grease cups, each end of the spring can easily be filled with grease. In this way sufficient grease is provided completely to lubricate the leaves for approximately 1000 miles.

Tests made by the designer of the self-lubricating spring showed that old springs drilled with overlapping grease slots and filled with an ordinary grease gun, not only produced greater flexibility and freedom from squeaks but also materially increased the mileage received from a set of tires. Cushioning the spring leaves with grease also saves motor and chassis from a certain amount of devastating vibration.

The self-lubricating springs are made in sizes to fit any make or type of car, and are reinforced. By drilling the standardized slots in the leaves, old springs that are still in good condition can be made self lubricating.

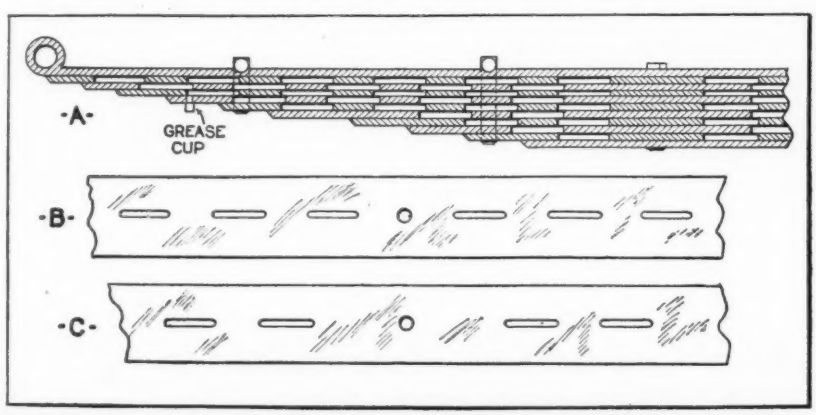
Physiological Experiments Make Vehical Tunnels Possible

HOW modern tunnels for vehicles under rivers, such as the Holland Tunnel under the Hudson, have been made possible by means of experiments on animals and experiments in which full-sized autos were driven through a small experimental tunnel, is revealed in a report to the Engineering Foundation in New York by A. C. Fieldner, chief engineer of the experiment station division of the United States Bureau of Mines.

When the Holland Tunnel was first proposed, says Mr. Fieldner, many engineers thought that it would be impossible to ventilate. The amount of poisonous carbon monoxide given off in the exhaust was thought to be so great that it could not be carried away.

Experiments made by Professor Yandell Henderson at Yale University showed that as much carbon monoxide in the air as four parts in 10,000 would not be harmful if the exposure did not exceed an hour. The first experiments were made on animals, then Professor Henderson and his students tried it on themselves.

Then an experimental tunnel was built at the experimental mine of the Bureau of Mines near Pittsburgh. This was nine feet wide, eight feet high, and 400 feet long. Above the ceiling was an air duct three feet



Self-lubricating spring. The spring leaves are pierced with slots at intervals, slots of adjacent leaves overlapping as shown in sections A and B-C

high, and below the floor was one two and one half feet high. Either could be used for introducing fresh air or for exhausting contaminated air.

Small automobiles were driven back and forth through the tunnel at a speed of 10 miles an hour, and at 40-foot intervals. Tests were made with various methods of removing and admitting the air, and examinations of the drivers by blood tests were made before and after. It was found that the most efficient method of ventilating was to admit the fresh air at the bottom and to remove it at the top.

Another safety device developed by the Bureau of Mines which is in use in the Holland Tunnel is an automatic carbon monoxide recording machine, which rings a bell and flashes a danger light when the gas becomes more concentrated than four parts in 10,000. Then immediate steps can be taken to increase the circulation of air.—*Science Service.*

Correction—Byrd's Coffee

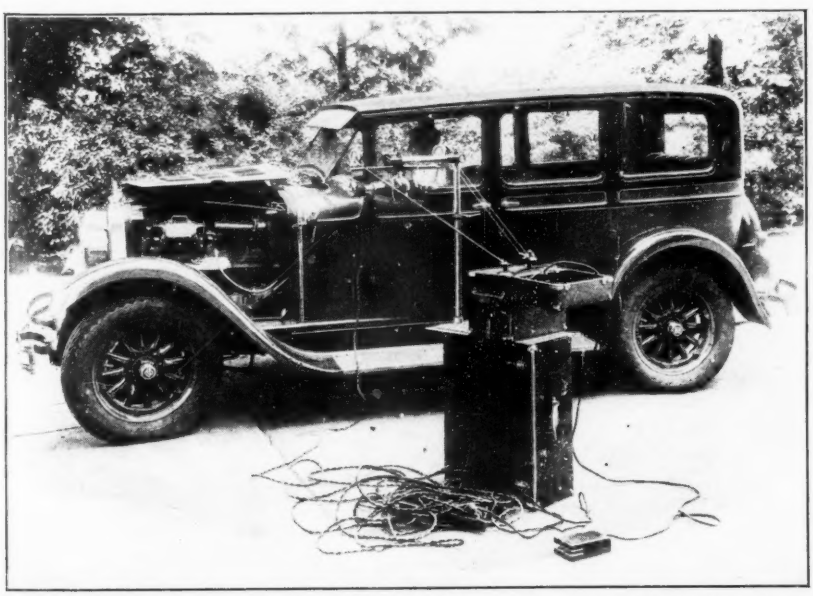
IN our November issue, under the title "Stocking Up An Expedition's Larders," an error was made in telling of the coffee to be used on the Byrd antarctic expedition. The coffee taken on board the ships was the well-known Bokar, supplied by The Great Atlantic and Pacific Tea Company, Inc.

Doctor Equips Car With Portable X-Ray Set

IT is generally conceded that "if the mountain can't come to Mohammed, Mohammed must go to the mountain." But if Mohammed chanced to be urgently in need of an X-ray diagnosis, and unable to go to the hospital to have his interior photographed, it is quite likely that he would dictate a note to Dr. C. B. Moses of Buffalo, New York, requesting the doctor to call at once with his portable X-ray equipment.

Dr. Moses has attached a generator to the cylinder block of his Dodge sedan, and the motor supplies the power. Permanent wiring leads from the generator to a socket on the dash board of the car, where he can plug in a flexible cord of sufficient length to permit operation of the X-ray machine in the patient's room. We have been informed that the idea of equipping a motor car with a portable X-ray outfit is original with Dr. Moses and that this is the third car of this make which he has so equipped.

The complete equipment is carried in a case no larger than a steamer trunk. Dr. Moses is a member of the staff of the Deaconess Hospital of Buffalo.



The portable X-ray outfit built by a Buffalo doctor on his Dodge sedan, the motor of which drives a generator which, in turn, supplies the power

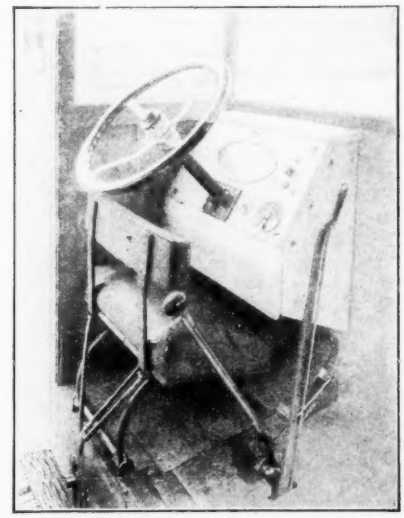
Stand-Up Drive Milk Delivery Car

A NEW type of delivery truck especially designed to serve house-to-house routes has appeared on the automotive scene. It is claimed that this new vehicle, made by the Step-N-Drive Truck Corporation of Buffalo, New York, combines the advantages of the old horse and wagon days and those of the modern motorized deliveries.

Entrance to the stand-up drive truck may be from either side, the floor being on a level with the axles

The outstanding feature of the new truck is its drop frame construction enabling the operators to drive either in a standing or sitting position. As the truck body is open throughout, the driver is able to work his load from the front seat, thus obviating the necessity of a trip to the back of the truck to get the orders which are to be delivered.

The driver of one of the new trucks may sit down while driving to his first call in the morning. As he leaves his truck for his first call he can fold the seat up under the steering wheel and thereafter make his house-to-house calls driving in a standing position. The truck is so constructed that the driver can enter from either side.



Driver's position in the stand-up drive delivery truck. Note folding seat, and clutch in left corner

While driving, the driver is protected from the weather and is wholly inside the truck.

Driving in a standing position is accomplished by using a combination foot brake and clutch pedal. Partly pushed in, the single pedal acts as a clutch; fully pushed down it acts as a foot brake. Regular pedals are used for driving while seated and the steering wheel has been angled so that it is in a comfortable position for handling either standing or seated.

In addition to the usual foot accelerator, there is a hand accelerator on the gear shift lever for regulating the speed while driving in a standing position. There are also the usual gas and spark levers on the steering wheel.

The truck is insulated at the sides, dash, and floor; and the motor is completely insulated from the body, allowing no heat, dirt, or odor to come into contact with the contents of the truck.

It is claimed that these trucks effect an economy of 40 percent over the old horse and wagon, and 25 percent over the standard type trucks.

Novel Heating System for New British Embassy

THE new British Embassy being constructed here will contain a new heating system which eliminates all radiators. The rooms are heated by small hot water pipes buried in the walls, ceilings, and floor.

The system is in use in England but never before has been installed in an entire building in this country.

In some of the rooms the entire walls and ceilings will be heated by the pipes, and in

others the floors will be warmed. This system was finally decided upon by the British officials in order to do away with all visible radiators and other heating devices.

—*Science Service.*

Use Aluminum Cans for Food Preservation

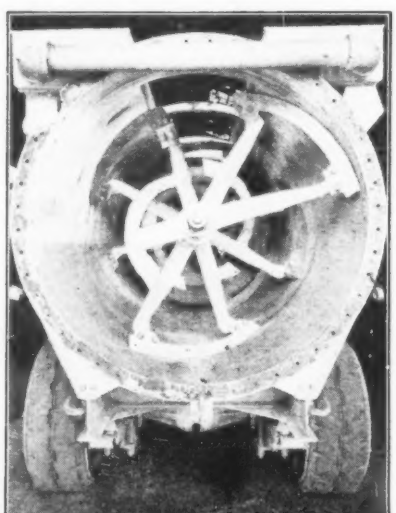
THE up-to-date housewife has for some time appreciated the value of aluminum for the cooking and preparation of foods, and now the commercial canners are beginning to realize that aluminum may turn out to be the ideal material for the manufacture of containers for canned foodstuffs.

Dr. H. Serger, a German investigator, has already obtained encouraging results on this point. He has found that aluminum is much less attacked by fruit acids than is the tin of the usual tinned iron cans.

—*Science Service.*

Smashing Atoms Costly Business

THE unlocking of vast stores of atomic energy must remain a 20th Century alchemists' dream for a while, if results



Interior of the concrete mixer-carrier truck showing rotating arms

of researches at the Physico-Technical Institute of Germany are substantiated. It requires too much bombardment to crack an atom.

According to quantitative measurements made at the Institute, the demolition of a single atom of aluminum or magnesium requires on an average 1,000,000 alpha particles, or free electrons. For the destruction of one boron atom, 100,000 alpha particles suffice.—*Science Service.*

Concrete Mixer-Carrier Truck

IN concrete construction work, the tendency in recent years has been to some extent toward transportation of premixed concrete from a central mixing plant. The belief is that specialists in concrete mixing can more easily maintain standard mixes according to specific formulae than can the contractor on the job who must depend on more or less inexperienced labor. The greatest drawback to this practice, however, is that unless the mix is constantly agitated, it will set rapidly in the transporting vehicle. Various methods of overcoming this have been developed and some of them have been very successful.

In San Francisco, the American Truck Mixers Company has solved the problem by developing a concrete carrying truck which not only agitates the mix while it is being carried to the job, but actually mixes the concrete. The mixer consists of a large tank mounted on a heavy truck. The mixing element, a large shaft passing through the center of the tank and equipped with arms connected in worm-screw fashion, is geared to the motor. The cylindrical tank does not revolve.

At a central plant, the gravel, sand, cement, and water are poured, in proper proportions, into the top of the tank. The ports are then closed and, as the truck proceeds to the job, the concrete is thoroughly mixed and kept in a state of constant agitation until discharged.

Vitamin B Split Into Three Parts

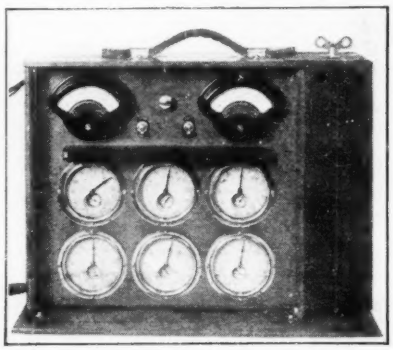
VITAMIN B is really triplets. The well-known food factor has been separated into three parts, each of which has different effects, according to a report by Charles H. Hunt of the Ohio Agricultural Station.

Two of the vitamins when fed together cause a moderate rate of growth. When fed alone each of these two causes only a slight increase in growth for a short time. The third, found in the residue from which the other two had first been separated, causes, when used alone, only slight growth for a short period, after which there is a decline. When this vitamin is added to the two others the excellent growth associated with the original vitamin B results.

Further tests showed that this third vitamin has all the characteristics of a vitamin in addition to being able to stimulate the other two so that they cause greater growth than when used alone.—*Science Service.*

Device Measures Automobile Jolts and Jars

ENGINEERS are constantly seeking to design automobiles that will ride more smoothly and comfortably, but so many road and car factors enter into the problem, and the sense of comfort of different passengers varies so greatly, that a more



Portable meter box, a part of the equipment for measuring car jolts

accurate method is needed to determine the riding qualities of a car than that of merely traveling in it over good, bad, or indifferent roads.

Numerous devices called accelerometers have been developed for the purpose of measuring and recording the jolts and vibrations to which a motor vehicle is subjected. The most recent of these is an electrical instrument developed by R. W. Brown, head of the engineering laboratory of the Firestone Tire and Rubber Company.

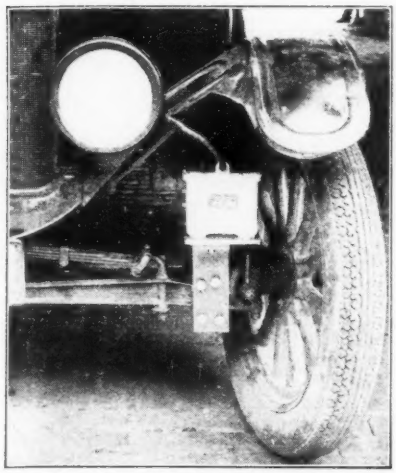
Because of its relatively small size and connection with the vibration counter through electric wires, this accelerometer can be mounted on any part of the vehicle, so that a record can be made of the vibrations at any place. Thus the action of the tires, axles, springs, body, and seats can be studied separately.

By using separate accelerometers located in various positions, the riding qualities of

The concrete truck which mixes a batch of concrete while transporting it to the point of discharge. The mix is kept agitated by a churning action

any individual portion of the vehicle can be segregated, all records being made at the same time and on the same piece of road. With such records the engineer can proceed to work out the characteristics needed for the improvement of each part.

The new instrument contains a series of



Automobile vibration recorder which may be attached to any part of a car

small weights normally held up against contact points by magnetism from an iron-clad solenoid. An upward force breaks the contact and the weights move downward against light springs, which also serve as lower contacts. By means of adjusting screws, each of the weights can be set accurately for a given force of acceleration, and by varying the electric current a wide range of forces can be measured.

So sensitive is the new instrument that it records variation of as little as five pounds in the air pressure in the tires.

Tractor Earth Boring, Pole Setting Machine

IN line construction and maintenance work, public utilities are often faced with many difficulties presented by hilly and rocky terrain, and the fact that the work must be done at great distances from highways. A new machine developed by the Highway Trailer Company, of Edgerton, Wisconsin, since it is mounted on a Fordson crawler tractor is capable of negotiating practically any sort of ground, bores holes for telegraph poles, and finally sets the poles. It is claimed that an average of a pole in the ground every five and one half minutes is being done in actual construction work at this time.

The boring unit of this machine is mounted in front and is capable of handling augers from eight inches up to 24 inches in diameter, the latter under favorable conditions. The multiple disk clutch of the boring unit as well as gears in the intermediate boring case operate in a bath of oil. Besides boring holes for poles, this boring unit will also dig at any angle necessary for all types of anchors.

Mounted on top of the machine is a 2500 pound capstan which is operated by the driver and from which the cable passes to a pulley at the base of the pole derrick, then to the top sheave. By operating this capstan, a pole up to 45 feet long may easily be lifted into place with the assistance of only one or two men to balance it properly. The whole derrick rises from 14 to 18 feet above the ground in a working position, but is dropped to a height of about eight feet for road travel.

Photographs Show Airplane Altitude

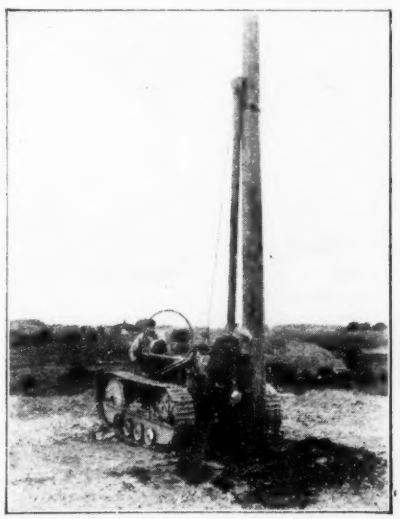
A NEW method of determining the altitude of airplanes above the ground is forecast as the result of photographs made on a recent record-breaking flight of the Army Air Corps. The flight was made by Captain St. Clair Street, accompanied by Captain Albert W. Stevens as observer and photographer. Although the Bureau of Standards has not yet checked up on their altitude, they are believed to have reached 40,200 feet, at which height they made photographs of the city of Dayton, Ohio. This altitude is higher than the present record for a plane with one man, two men, or photographic equipment.

Despite a scattering of clouds at 6000 feet, the photographs show the highways and outstanding structural characteristics of the territory below with remarkable clarity. So distinct are the pictures, in fact, that they could stand enlargement to 10 diameters. The high-altitude photographs taken by Captain Stevens offer a new method of obtaining altitude measurements. If three or more points on the ground are shown, the distances between which are known from accurate ground survey data, then by measuring the distance of the image separations on the negative and knowing the distance from the negative to the optical center of the lens in the camera, the problem of the length of the perpendicular dropped from the lens to the ground becomes a geometric one of similar triangle, and can be figured in feet or meters to within one tenth of 1 percent mathematical accuracy. Comparison of the results thus obtained with those gained from the barograph formula method employed by the statisticians, will undoubtedly prove both interesting and important.—*Science Service.*

Architect Wanted Tomb Like Queen's

THE strange story of Senmut, an Egyptian architect who wanted a kingly burial, is pieced together following the latest excavations at Thebes made by the Metropolitan Museum's Egyptian Expedition. (Refer to page 37 of this issue for other details.)

While digging around the ruins of a temple which Senmut built for the famous Egyptian Queen Hatshepsut, the expedi-



Setting a pole with one man's help by means of the derrick and capstan

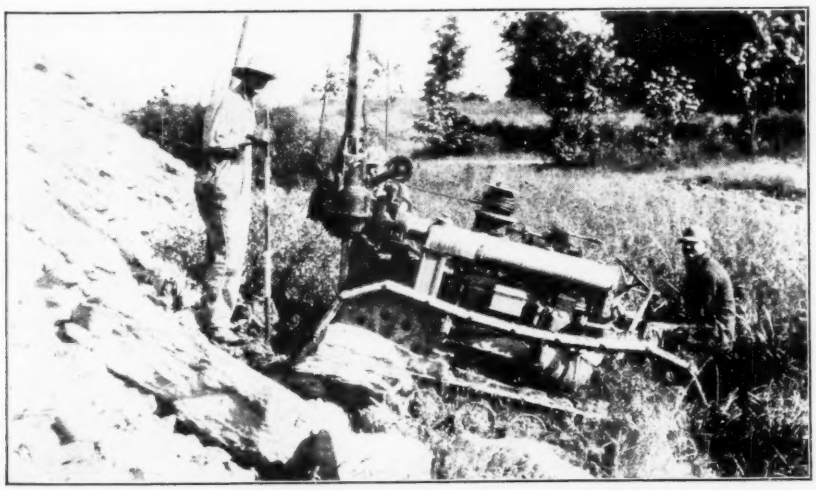
tion discovered steps leading down deep into the ground, H. E. Winlock reports. Here, 100 yards below the surface, was found the unfinished secret tomb which the architect was building for himself while he worked on the queen's temple.

Senmut stood so high in the favor of Queen Hatshepsut that he bore the high-sounding titles of Chief Guardian of the King's Daughter, High Steward of the Royal Household, Superintendent of the Royal Slaves, and Superintendent of the Royal Bedrooms. But this commoner yearned for permanent records of his close association with royalty.

Two years ago, this ambition was revealed when the expedition discovered that Senmut had ordered his own portrait introduced behind every door in the temple he was building.

"And now," says Mr. Winlock, "this past season we find him tunneling right under the temple enclosure to make a tomb for himself suggestively like Hatshepsut's."

(*Please turn to page* 88)



The new machine which bores holes for, and sets telegraph poles. It can negotiate rough ground and will bore holes vertically or at an angle

Learning to Use Our Wings

This Department Will Keep Our Readers Informed of the Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York City

Model Aircraft

WE have recently received two books on model aircraft construction which were somewhat of a revelation to us. One is entitled "Building and Flying Model Aircraft" by Paul Edward Garber (Ronald Press, New York City); the other is "Beginning to Fly" by Merrill Hamburg (Houghton Mifflin Company, Boston and New York). Both are excellently written, by evident masters of the art of model construction, and a prospective purchaser would find it hard to choose between the two. Anyone seriously interested in the art would probably find it worth while to secure both volumes, or consult them at a public library.

The model airplane has been a serious factor in the development of the airplane. The great pioneers of the early part of the nineteenth century, the Englishmen Henson and Stringfellow built most interesting power-driven models which were indeed the first ever to make a heavier-than-air flight. One of Stringfellow's models was 10 feet in span and two feet in chord. Equipped with a very light single-cylinder steam engine, and two gear driven propellers, it flew remarkably well.

Dr. Langley used many models in his researches, at first using rubber drive with the rubber both stretched and twisted. Subsequently he constructed a large model, 14 feet in span and powered with a one horsepower steam engine. This model, launched from a catapult, weighed 26 pounds and made a flight of three quarters of a mile. His last model was powered with a 3.2 horsepower gasoline engine and constituted an exact quarter-size duplicate of the full-sized Langley "aerodrome" which failed in its trial of December 1903, due to launching difficulties, but is nevertheless considered by many authorities to have been capable of real flight.

In the scientific work of to-day the model still plays an important part. In wind tunnel work exact scale models of aircraft are made, often to an accuracy of 1/200th of an inch, subjected to a steady air stream in the tunnel and used to determine the characteristics of efficiency and stability of an airplane in process of development. Some few years back, certain army and navy airplanes developed a curious "flat spin." In this condition the airplane would remain at a very large angle of incidence and spin around and around a vertical axis while dropping fairly slowly to the ground. The most powerful efforts of the pilot would fail to restore a normal attitude.

Plane after plane would land in this maneuver, fortunately with no injury to the pilot because the rate of descent was so slow. The mathematics and aerodynamics of the flat spin were so intricate that a final understanding of the phenomenon was arrived at only by the use of models, launched in a spinning attitude from a height of 100 feet or so, and either caught in a net or kept from damage by the use of an automatically released parachute.

The solution of the mystery was that the plane in a flat spin acted like a gyroscope, and therefore resisted any change in its plane of rotation. The flat spin can be avoided by more powerful controls and by such a distribution of the mass of the airplane that the moments of inertia about the three axes of the airplane are not too greatly different in amount.

Model aircraft are of utility moreover in making the youth of the United States airminded, and perhaps in awakening inventive and design genius. Grover C. Loening, Clarence D. Chamberlin, and many other well known experts in the field of aviation owe their start to model aeronautics.

Reading these two small books, one is amazed at the variety and extent of the model aircraft work which is available for boys generally and for manual training classes particularly. With a rubber driven model, Robert V. Juros, in 1924, while a student in a western college, made the astounding record of 7920 feet and a duration of 10 minutes 14.2 seconds. This record has never been surpassed.

Model gliders are simplicity themselves and serve as a useful introduction to the finer points of the model game.

The interest of flying a kite can be enhanced by using a model parachute. The parachute is hooked by a ring to a wooden traveler, with a screw-eye and wire release. When this is placed on the kite line, the wind seizes the 'chute and carries it and the traveler aloft to the kite, where the wire release hits a button and the 'chute is released. As the traveler comes back down the line like an express train, it is better to stop it with a heavy stick rather than with the hands, so as avoid injury.

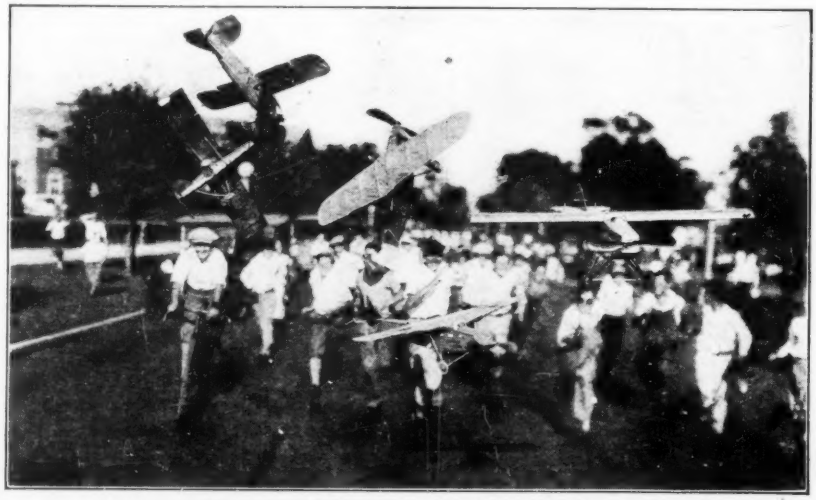
Another method of releasing a parachute from a kite is to attach it to the kite, before ascension, with a piece of "punk" which in turn is lighted and tied to the kite. The kite is then flown with the 'chute attached, but when the punk burns down to where the string is tied the chute is released. The slow and graceful descent of a parachute from a high flying kite, as described by Mr. Garber, is a pretty sight and adds greatly to the thrill of kite-flying.

Mr. Garber also describes the very interesting process of building and flying model balloons, and gives explicit instructions for the building of compressed-air motors. The use of compressed air seems to be a most promising method of flying power-driven models, although gasoline engines are now also being used successfully.

Aviation in Central America

AIRWAY AGE summarizes the plans of Pan American Airways in a recent issue. Under contracts already awarded by the Post Office Department, the company will operate air routes 4023 miles in length and extending through 12 different countries. The company is now carrying passengers from Miami to Havana and return daily. Very shortly it will inaugurate three round trips a week between Miami and Porto Rico. The net work of air lines which is sketched out on our map is in active preparation, and airports are being built at Camaguey, Cuba; Santiago, Cuba; Port au Prince, Haiti; Santo Domingo, Dominican Republic; and San Juan, Porto Rico.

The flying equipment will consist of large



An unusual action photograph of model airplanes in the air

three-engined planes, for which negotiations are being made with the Atlantic Aircraft Corporation and the Sikorsky Manufacturing Company. Loening Amphibians will be used for special services.

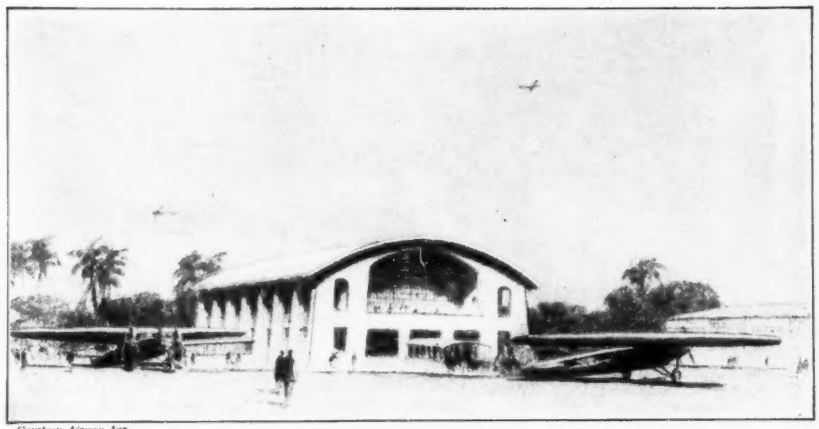
Careful attention is also being given to traffic arrangements with railways on the Atlantic seaboard, travel bureaus and the new consolidated aviation ticket office. Traveling by way of the Atlantic Coast Line Railroad and the Florida East Coast Railway a passenger is now able to leave New York City in the evening and be in Havana on the morning of the second day.

The Miami terminal of the Pan American Airways, which represents the operating headquarters of the company, will be one of the best equipped airports in the world. It will include a passenger station, hangars, and machine shops, as well as headquarters for customs and immigration officials.

It has long been predicted that instead of the well constructed but rudimentary hangars of to-day, architects would step in and design air terminals as well arranged and as sound architecturally as some of our great railroad terminals.

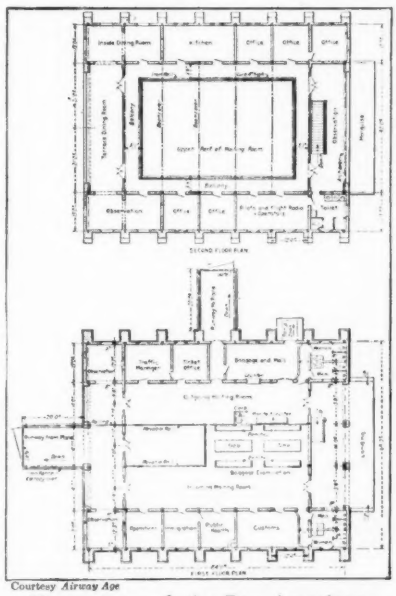
The passenger station at Miami has been designed by Delano and Aldrich, one of the outstanding firms of architects of the day. The terminal will include a reception room for visitors, and a spacious waiting room. A restaurant on the grounds will be provided with terraces arranged so that a clear view can be had of the movement of the airliners. A mezzanine balcony will be available for social functions.

Pan American Airways is controlled by the Aviation Corporation of America, which includes on its board of directors eminent bankers, operators, and business men. There is no doubt that the company will establish the United States very firmly in Central American aviation.



Courtesy Airway Age

An artist's conception of the terminal of the Pan American Airways at Miami, Florida. This is a two-story building, floor plans appearing directly below



Courtesy Airway Age

Floor plans of the Pan American Airway terminal. Notice how every desire of the potential air traveler is adequately provided for

The Hazard of Lightning

PROFESSOR ALEXANDER McADIE, writing in a bulletin of the Daniel Guggenheim Fund for the Promotion of Aeronautics, gives an interesting summary of our knowledge of lightning. From the weight and fusion energy of a number of kite wires destroyed by an electric discharge he computes the instantaneous energy of one discharge to be of the magnitude of 7.5 kilowatt-hours. In some cases Professor McAdie estimates the voltage to be 50,000,000.

At any rate, an intense lightning flash can splinter struts, fuse the bracing wires, tear the fabric off a plane and kill the aviator. There is a double danger, first from the lightning and second from the existence of wind gusts, vertical as well as horizontal, which make it very difficult for even a skilful flier to control his plane. The catastrophe of the *Shenandoah* may illustrate the latter danger. It was apparently not the lightning but the up and down gusts of the air which brought disaster.

Airmen should keep a vigilant lookout for thunder clouds (cumulo-nimbus as the meteorologist calls them) and steer a course away or around them. It should be also possible in many cases to fly above the thunder cloud for many of them are below 10,000 feet. Professor McAdie predicts that there will be installed at airports, apparatus whereby the potential gradients of the air can be determined and approximate electric field strengths given. It may be also possible to invent apparatus which will automatically warn the pilot of the approach of dangerously charged clouds.

Courtesy Airway Age

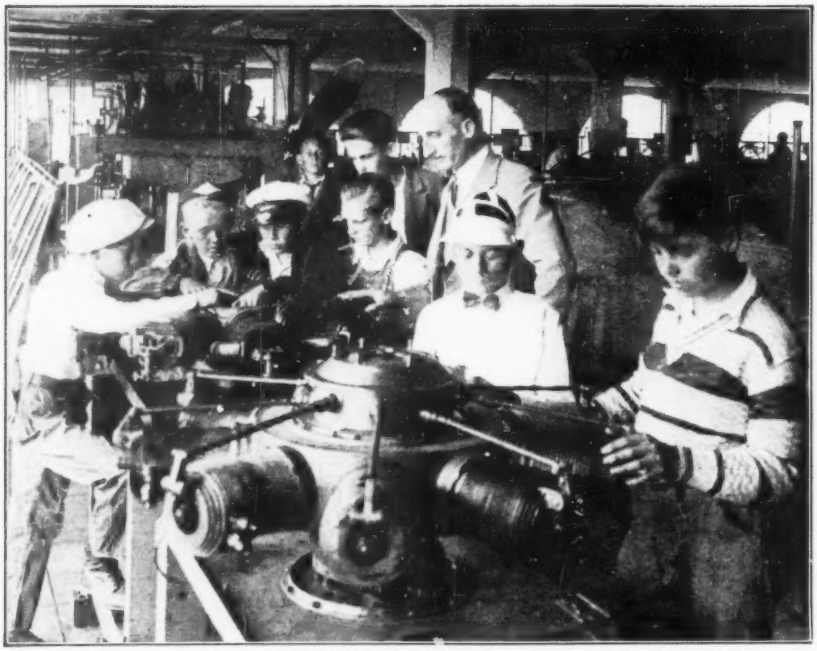
Map of the routes of the Pan American Airways. See text and other illustrations

Aviation in the Schools

THERE are now quite a number of universities offering complete courses of instruction for aeronautical engineers, including highly technical training. There is the usual engineering foundation of advanced mathematics, applied mechanics, theory of heat engines and so on. This is followed by specialized work in aerodynamics, theory and design of the airplane, theory and design of the aircraft engine, propeller design, structural analysis and other subjects of vital interest to the airplane constructor of the future.

It may be said that the advanced instruction of the aeronautical engineer is now well taken care of, and offers no anxiety to either educators or industry, but there is another educational problem in aeronautics which yet remains unsolved: the introduction of aeronautics into the high schools of the country. A special committee has been appointed by the Daniel Guggenheim Fund for the study of this problem.

Since even to-day not every high school



Instilling air-mindedness in the youthful scholar. In this illustration boys are busily engaged in the study of an air-cooled engine of conventional design

boy is going to enter college, how far should the high school attempt instruction in aeronautics for a boy who is not proceeding to college? Should the high school, and in particular the technical high school, attempt to give him the elements of aerodynamics and airplane theory, teach him airplane drafting, airplane assembly and rigging, and the care of the aircraft engine? Is there not a danger that such specialized work may displace from the boy's curriculum fundamental subjects of a more general character which will better fit him for the unexpected exigencies of industrial life?

It is interesting to learn that a number of schools, more especially in the west, are attempting such instruction. In Los Angeles, in many ways one of our most progressive cities, a free aviation school for boys has been started. The 12 weeks' course includes instruction in the theory of flying and in the practical aspects of aircraft engines. Some 2000 youngsters are concerned. Our photograph shows the boys at work, busily engaged on an air-cooled engine. A gigantic model plane meet concluded the first course.

The Rohrbach "Romar"

AMERICAN constructors have not of late years given the large three-engined commercial flying boat the attention that it deserves. The Germans have developed this type intensively and their practice deserves very careful study. The Rohrbach Company of Berlin has quite recently produced a very large flying boat which is intended for use between South America and Spain. This is known as the Rohrbach *Romar*, and was built on special order for the German Luft-Hansa, the great German air transport service.

The *Romar* is equipped with three engines, giving a total of 2160 horsepower. It carries 12 passengers and a crew of five men, and has a range of nearly 4000 kilometers or about 2500 miles, with a pay load of 2400 pounds. With a span of 113 feet, and a wing area of nearly 1900 square feet, the gross weight is approximately 42,000 pounds. Maximum speed is 136 miles per hour.

An outstanding feature of the *Romar* is the care which has been taken to supply the huge flying boat with every possible aid to navigation, auxiliary apparatus and safety devices. The construction is of the well known Rohrbach type, entirely in dural, with wings and hull covered with dural sheet. The accompanying drawing gives probably a better idea of the arrangement of the flying boat than could any photograph.

The items on the drawing are as follows:

(1) is a collision compartment. This is a watertight compartment which serves to protect the rest of the hull in case of a bad landing, or a crash into the side of a dock.

(2) is a special sound-proof room for the wireless operator and the navigator. There is plenty of room here for astronomic navigation.

(3) is the pilot's compartment. It is entirely enclosed but provides ample vision through the windows of Triplex glass.

(4) is a large 12-passenger cabin provided with good head and aisle room. Nothing is so important as to give the passengers a sense of spaciousness in long distance flights.

(5) is the entrance hall and stairway. The entrance is correctly placed at the back of the cabin, so that passengers are far from the propeller blast. With the boat set down low by the tail there is maximum ease of entrance into the boat.

(6) is a baggage compartment entirely distinct from the passenger cabin. Carrying baggage together with the passengers is considered to be a highly dangerous practice, since there is hazard of passenger injury by shifting of heavy baggage.

(7) is the compartment reserved for the mechanics who have from this spot the readiest access to the engines.

(8) and (9) are the wireless and light generators, which are presumably wind driven.

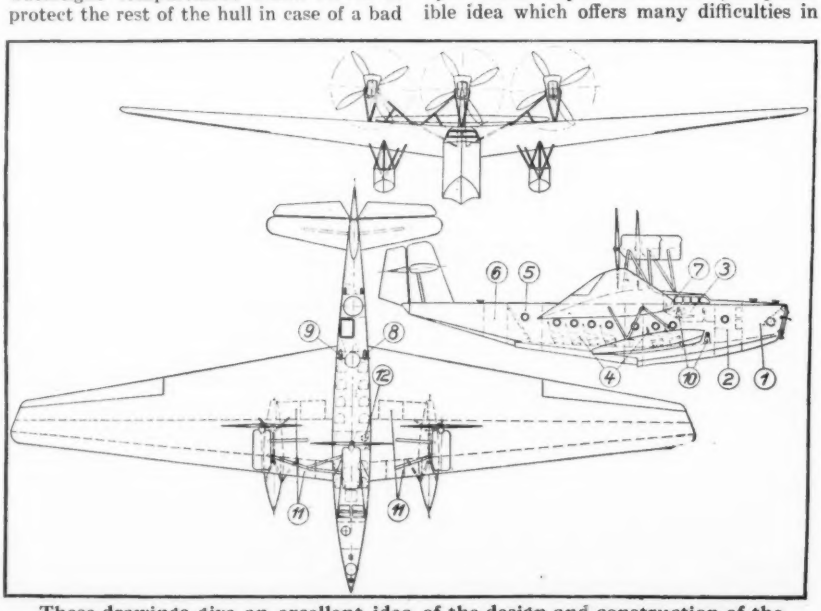
(10) is an auxiliary engine which can no doubt be used to drive the generators when the seaplane is at rest on the water, a particularly useful precaution in case of forced landing.

(11) indicates the tanks placed in the leading edge of the wing so that the blast of air may be relied upon to extinguish a fire.

(12) is the indispensable wash-room.

Parachute for the Entire Plane

A paper which attracted considerable interest at the Congress on Safety in Aviation was that of Major E. L. Hoffman, of Wright Field, who discussed the question of parachutes. It is held by most authorities that individual parachutes for the average passenger are out of the question. Sliding the passenger through the floor, with a parachute attached to his seat which will open up automatically as the seat falls, is a plausible idea which offers many difficulties in

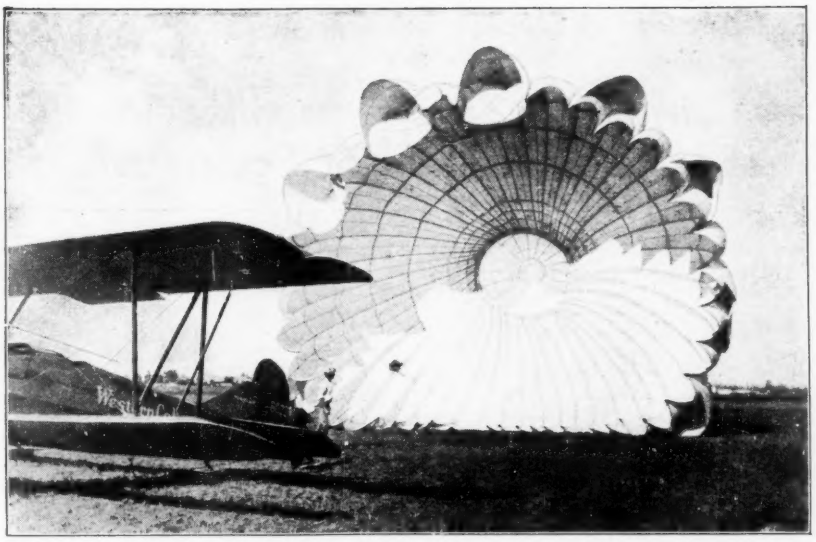


These drawings give an excellent idea of the design and construction of the Rohrbach *Romar*. In the text are given the designations of the numbered parts

its realization. Attaching a parachute to the cabin and releasing the cabin in an emergency is also a doubtful solution.

Major Hoffman made a strong case for the parachute large enough to support an entire plane. He has actual experiments to back up his views. He has already made tests with a giant 'chute, 84 feet in diameter, which successfully carried to the ground a 1600-pound bomb. The preliminary test offered one difficulty, however. When the 'chute landed it refused to deflate, and an automobile had to be used to chase the errant and billowing giant across a field.

The next experiment will include a quick-release mechanism. When the 'chute is used for a whole plane, the pilot will actuate the release mechanism just before landing. Similar experiments are also being made by a west coast aviator, Herd McClellan. His parachute measures 85 feet in diameter. Its huge size can be gauged by comparison with a Travel-Air plane, as shown in our photograph.



Experimenting for safety with a huge 'chute capable of lowering an entire plane

Policemen of the Air

THE Rules of the Air as devised by the Department of Commerce have done much to increase aviation safety. Generally speaking, aviators are only too anxious to observe such rules, but as air traffic increases, black sheep may creep in and it will be quite a problem to enforce the rules with the rapidity which is essential in flying. There is also the difficulty of signalling to the pilot who is breaking rules. The police force of San Diego has hit on a very simple method. When an aviator is stunting over prohibited areas, flying too low or breaking some other regulations, the flying policeman shows him the side of his fuselage on which is painted in huge letters, the curt sign, "Land At Once."

Aircraft Diesel Engines

FIRE prevention has and is engaging the attention of aeronautical engineers in every civilized country. The French in particular are encouraging the production of such devices as will prevent a back fire from reaching the carburetor, will automatically extinguish incipient fires, and so forth.

The very best method of preventing fire, however, would be to use a heavy non-inflammable fuel, but such a fuel cannot be used in an engine of the ordinary gasoline type. It can only be employed in the Diesel or semi-Diesel. In the Diesel engine, the compression at the end of the compression stroke may be as high as 550 pounds per square inch, and fuel is injected as a spray under a pressure of as high as 1100 pounds per square inch, a two or even three-stage compressor being needed for the fuel injection. In the semi-Diesel there is the same injection of fuel at the end of the compression stroke, but lower pressures obtain both in the cylinder and in the injection of the spray, and a hot-spot has to be provided in the clearance space.

The Diesel and semi-Diesel, because they work at such very high pressures, are much more efficient than the ordinary gasoline engine, but owing to the enormous pressures in the cylinders and due to the compressors required they are apt to be very heavy for a given horsepower. Also, the injection of fuel at the top of the stroke limits the speed of the engine. In spite of these difficulties the Packard Company announces that it has developed an aircraft Diesel engine, which has been flown in a Stinson-Detroiter cabin monoplane of standard design.

The Packard aircraft Diesel is of the radial air-cooled type, developing about 200 horsepower and weighing less than three pounds per horsepower. No other details have been disclosed so far by the Packard Company, and since no information will be given out until a comprehensive program of ground and flight tests has been completed, it is possible only to speculate.

We believe that the engine is of the semi-Diesel rather than the full Diesel type; that both the compression and the injection pressures are far less than in the Diesel engines used in stationary practice; that to secure lightness, steel cylinders of great unit strength have been employed instead of cast iron; that dural has been used freely in all other parts with lightness in view; that a single-stage compressor of the impulse or plunger type is employed; that a single compressor is used with a suitable distribution of pressure to each cylinder; that extreme care has been used in the design of the injection valve; and that some device has been used to secure complete mixture of the fuel with the compressed air in the cylinder as well as rapid combustion.

It is the opinion of many authorities, as a result of the long experimental work which has been carried out both here and abroad on the automotive Diesel engine, and the great deal of research work carried out on fuel injection, that all the elements of the aircraft Diesel are already at hand. Engineers will refine further and assemble these elements in practical form.

The Diesel engine, dispensing as it does with carburetor and ignition system, will greatly increase the reliability of the aircraft power plant, as well as eliminate the fire hazard. We do not believe that there will be at first a very great reduction in the fuel consumption per horsepower-hour, because the pressures employed in the aircraft Diesel or semi-Diesel will not approach those of the stationary Diesel. Eventually a compromise will be arrived at between weight and fuel economy. Particularly for long distance flights will increased economy in fuel consumption permit of the use of an engine of somewhat greater weight per horsepower than in the present gasoline type.

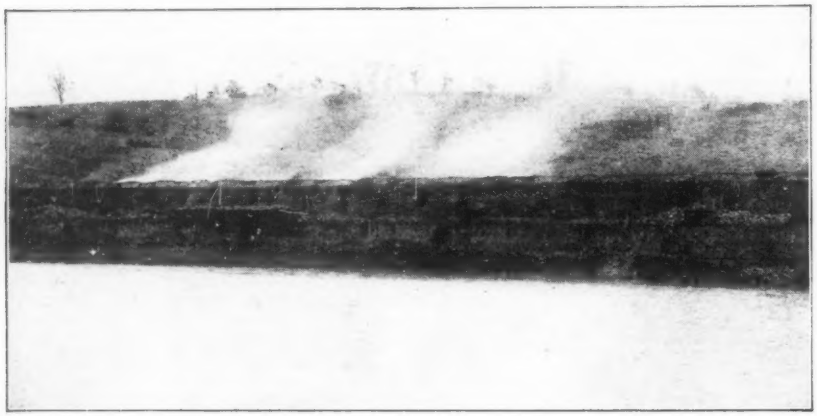
Aerial policemen in California now use this flying sign to warn law violators

Industries From Atoms

A Department Devoted to the Advancements Made in Industrial and Experimental Chemistry

By-Product Process Has Almost Supplanted Beehive Coke Ovens

BY-PRODUCT coke has replaced all but 15 percent of the coke produced in the United States, rising from 27.5 percent in 1913 to 86.2 percent in 1927, according to C. J. Ramsburg, vice-president of The Koppers Company, Pittsburgh.



Typical installations of beehive ovens for coke manufacture. This type of oven was formerly common throughout the soft coal districts, but is now becoming extinct due to the increasing use of by-product ovens. The clouds of smoke arising from these ovens contain waste ammonia, benzol, coal tar, and other valuable substances which are saved in the modern by-product ovens

Mr. Ramsburg says that the influence of chemical engineering and chemical research since the World War, has been greater than that of any other branch of technical knowledge. It has been in the same period, he explains, that the by-product coking industry has made such great strides in America. By 1929 Mr. Ramsburg expects by-product coke to account for 90 percent of the coke produced in this country.

"By-product coke plants will be built for city gas and for domestic fuel supply," he says. "At present a large number of cities in the United States receive a substantial part of their gas from coke ovens. About 20 percent of the gas distributed by manufactured gas companies now comes from coke ovens.

"The gas industry is a unit in the belief that in the future the base load gas for practically all locations will be coke oven gas or coal retort gas and for this reason there probably will be a large number of small and some large plants built in the future."

Methane as Successor to Present Manufactured Gas

REVOLUTIONARY developments in the chemistry of gas may make it possible for the gas companies of America to produce a harmless form of gas which can be breathed in quantity without danger or discomfort, Arthur D. Little, eminent consulting chemist and President of the Society of Chemical Engineers, declared at the recent convention of the American Gas Association.

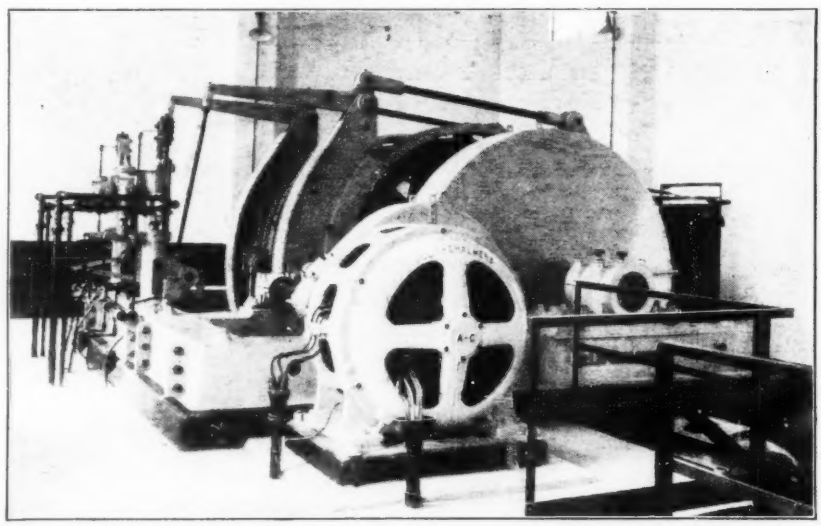
The new gas, Dr. Little explained, can be derived from the conversion of water gas to methane or from the direct catalytic treatment of mixtures of coal gas or coke over gas with water gas in such balanced proportions that the required hydrogen is present in the proper ratio to the carbon monoxide for the production of methane. Dr. Little said the methane would double the energy-carrying capacity of the industry's distribution systems and would enable the gas companies to furnish gas which would require no primary air at the burner.

Speaking of the production of "dry ice" as a major by-product in the manufacture of methane, Dr. Little said: "If the price of solid carbon dioxide, which is now selling at five to ten cents a pound, could be reduced to two cents, an unlimited field for its use would be opened up. The gas company would then be a logical producer of the material and might be able to take over the distribution of both heat and cold commercially. A gas works of the size of that of Boston, operating on the methane cycle, would be able to produce about 500 tons of solid carbon dioxide daily, the equivalent of 1500 tons of ice."

It is also possible, he said, to develop methods by which the gas industry will be definitely tied in with the production of motor fuel. He said his laboratory had demonstrated one such method by which, through the vapor-phase cracking of gas oil, there is obtained 1200 cubic feet of 1500 B.T.U. gas for enrichment use, together with 12 to 14 gallons of crude motor spirit, four gallons of fuel oil and 14 to 16 gallons of cycle stock.

Cure For Carbon Monoxide Poisoning

DEADLY carbon monoxide, a constituent of illuminating gas and automobile motor exhaust, takes a constant toll of life from the careless and unfortunate. Because it combines so avidly with human blood, the treatment of victims by ordinary methods of resuscitation is almost futile. Recently, however, a method for the cure of carbon monoxide poisoning was reported by L. Schmidt of Kiel, Germany. By



Recently installed hoist in a Portland cement mill at Thomaston, Maine. Limestone, quarried nearby, is elevated to the crushing plant by means of this hoist, which is operated by a system of relays without attendants. In operation, it gives an uncanny impression of human intelligence as the nine-foot drum-hoist starts and stops at the will of the distant operator

confining cats, rendered unconscious by carbon monoxide, in a chamber filled with pure oxygen in which the pressure oscillated between 2.3 and 2.5 atmospheres in synchronism with the breathing of the cats, the specimens were revived in two minutes and were removed from the chamber in full health within a half hour.

Sulfur Recovered In the Gas Plants Is Boon to Farmer

RECENT reports from the Pacific Coast again describe the remarkable variety of sulfur recovered by many of the larger gas plants and used with effective results in agricultural work.

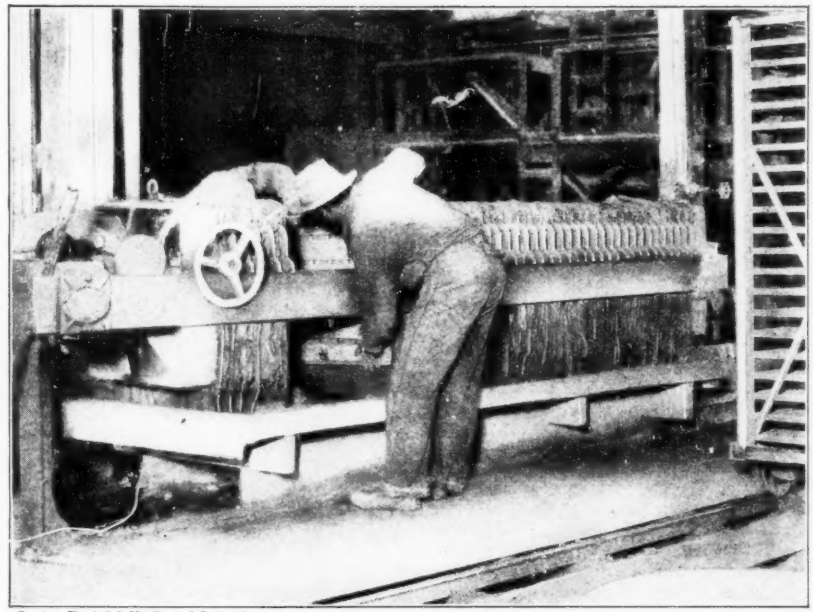
According to K. N. Cundall of the Pacific Gas and Electric Company, San Francisco, the sulfur has unusual properties as an insecticide and fungicide while, in addition by reason of its extremely small particle size, it shows marked activity in the neutralization of alkaline soils.

"Sulfur recovered by gas plants," Mr. Cundall reports, "has been tried recently on such blights as asparagus rust, peach, apple, and rose mildew, and rust on prunes. Additional work has been done with the cotton leaf hopper and lettuce mildew, and as a soil fertilizer and neutralizer for black alkali.

"The sulfur has been applied in districts ranging from Mexico to Canada, east to the Mississippi, and through the cotton belt in the South. It has been interesting to note the rapidity with which alkaline soils may be reclaimed through comparatively small amounts of the product. One user reports that he was able to plant alfalfa within three months' time after an application, when ordinarily a whole season would have elapsed before suitable results could have been obtained.

"Tests made in two sandy California soils showed the speed of oxidation to sulfate of recovered sulfur as compared with two commercial brands. The recovered sulfur was from 20 to 30 percent more nearly oxidized within a three months' period than were either of the two commercial grades which were simultaneously used.

"Additional tests on three species of red spider showed that the recovered sulfur has remarkable killing power as well as excellent spraying qualities. Considerably less is required of the recovered than of the commercial grades. Other tests have failed to produce another form of sulfur which is superior to the recovered product for use as an insecticide and fungicide in a whale oil soap."



Courtesy *Chemical & Metallurgical Engineering*

Filter press used for preparing cakes of recovered sulfur sludge for the tunnel drier in a California gas plant. The sludge is dried in order to sell the recovered product in competition with commercial brands in a lime-sulfur mixture or as a dry gray dusting powder. It has been demonstrated that it is possible to dry this sludge several different ways without injuring its toxic properties. The recovered sulfur has unusual properties as an insecticide and fungicide, and exhibits marked activity in the neutralization of alkaline soils, according to tests recently held in widely scattered sections of the United States

Most of the recovered sulfur particles are smaller than 15 microns and many are too small to be measured.

Sacking powdered tin oxide for re-use in weighting silk, after the wash-water sludge has been dried in the spray tower. The illustration shows the base of the spray tower, where the recovered tin oxide is being sacked

Wax Crayons From Coal Tar

THE suitability of wax extract from coal tar produced in the low-temperature carbonization of coal, for use as a base in the manufacture of colored wax crayons, is being investigated at the Pittsburgh Experiment Station of the United States Bureau of Mines, Department of Commerce. Several commercial colored crayons have been analyzed and similar crayons have been made up, using the tar wax. From experiments so far made this wax appears very well suited to the purpose. It has a high melting point, which doubtless will render its use advantageous in making crayons for particular purposes.

Reclaiming Tin From Silk Weighting Washings

ONE of the steps in the weighting of silk consists of immersing the de-gummed fibers in a solution of stannic chloride. After the required time, the silk is removed and placed in washing machines where it is treated with large volumes of water to precipitate the tin absorbed by the fibers as an insoluble hydroxide or hydrated oxide, and to remove the excess stannic chloride. While the percentage of tin contained in wash waters is very small, it represents approximately one third of all the tin used by the weighters, and when salvaged, its value is considerable. The efficient and complete recovery of this tin is therefore of great importance.

Gibson Buttfield, writing in *Chemical and Metallurgical Engineering*, describes the novel process used in recovering the tin contained in the one million to four million

gallons of water used in large silk plants.

In the operation of the new process, the tin-bearing solution, on leaving the wash machines, is neutralized by the automatic and continuous addition of a lime slurry, thus securing practically complete precipitation of the tin. The precipitated tin is allowed to settle and the sludge is continuously pumped to an overhead storage tank, flowing thence by gravity to a spray drier where it is instantaneously dried and automatically delivered to barrels or bags, for shipment. Continuous operation, from the time the solution leaves the wash machines to the shipment of the oxide, is the result.

Surplus Military Explosives Used Industrially

MORE than 126,000,000 pounds of TNT and other surplus military explosives accumulated by the government at the close of the World War have been used for industrial purposes, states Dr. Charles E. Munroe, Chief of the Explosives Division, United States Bureau of Mines, Department of Commerce. These explosives have been used in road building, in construction of dams and reservoirs, in draining swamps, in clearing cut-over lands and for other useful purposes which have added materially to the wealth of the nation.

After the entrance of the United States into the World War the nation set about the production of military explosives on a scale never before undertaken, and this work continued with such acceleration that when the armistice was declared, the country was producing military explosives in quantities never before realized. There is little doubt, Dr. Munroe points out, that this developed capacity was a material factor in ending the War. A consequence, however, was the accumulation at various points in this country of enormous stocks of high explosives and propellents, whose safeguarding during storage and transportation constituted a serious and costly obligation, while entailing a menace to the communities near which the material was stored.

Inspection and testing of the TNT stored for ten years have shown the explosive to be in the first-class condition and entirely suitable for use as a blasting agent.

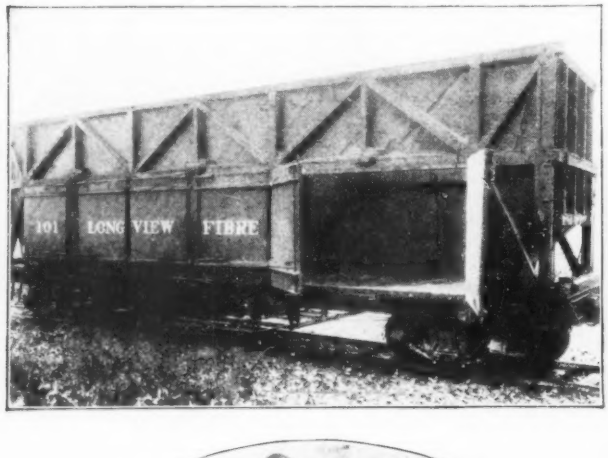
Eliminating Odors in Paper Making

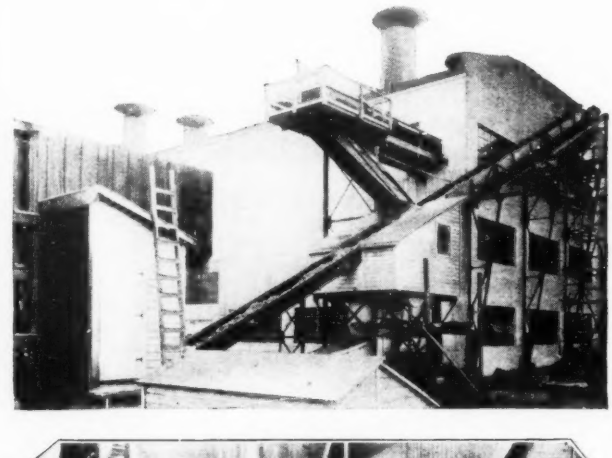
EVER since the infancy of the science, chemistry has been popularly associated with evil smells. While the characteristic odor of some laboratories and chemical plants provides a basis for such an association, it must be said in fairness to the chemist that his efforts in eliminating unpleasant odors are just as effective as in creating them.

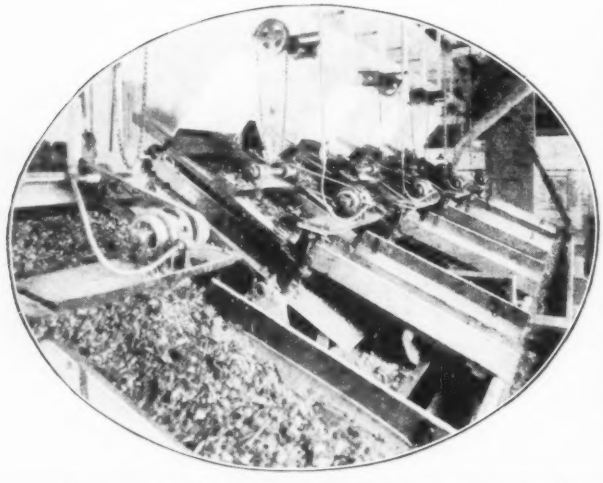
A case in point is described by R. S. Wertheimer in a recent issue of *Chemical and Metallurgical Engineering*. An important factor in limiting the development of the kraft-paper industry has been the obnoxious odor, produced in recovery of the spent cooking liquor. This fact has precluded the establishment of plants in thickly settled communities where manufacturing facilities are most suitable, and has forced development in isolated places, often with greatly increased capital and operating costs. By skillful application of chemical engineering, the Longview Fiber Company has eliminated this nuisance, and erected a modern mill at Longview, Washington, in which wrapping paper is produced from waste fir lumber without offending the most sensitive nostrils.

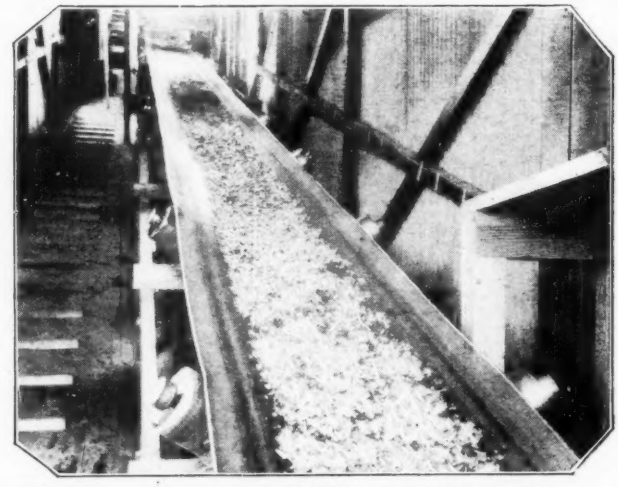
This new mill is also note-worthy in that it uses refuse fir lumber exclusively for its pulp and for fuel in its power plant. The mill adjoins the property of the Long-Bell Lumber Company, the largest lumber mill in the world. The scrap lumber is chopped up into chips for pulping and for fuel under the boilers.

Malodorous vapors from the digestors, wherein the chips are cooked to a pulp, are conducted to a large condenser which removes part of the unpleasant constituents. Condensate and non-condensable gases are then led to a gas washer from which they are removed under pressure to furnaces in

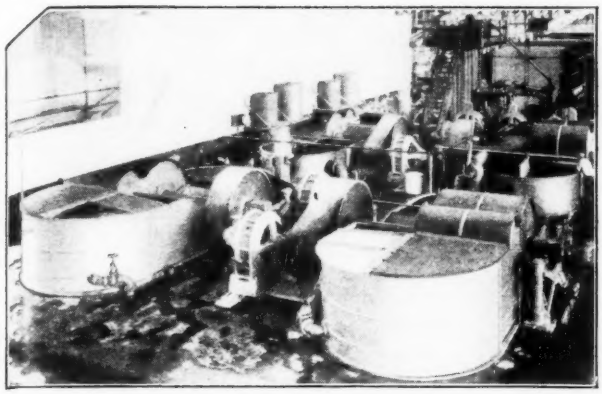


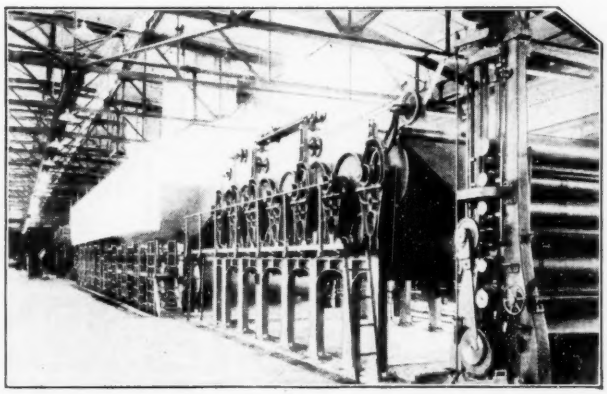


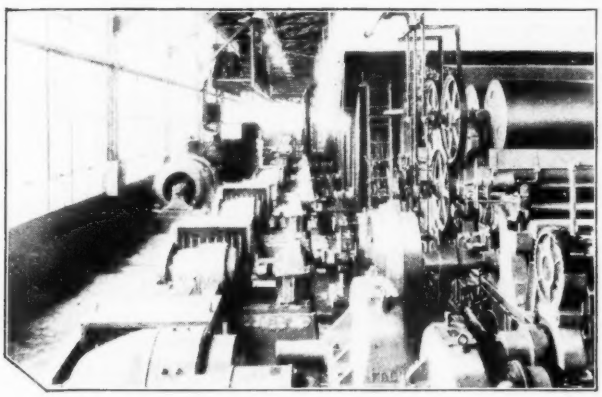


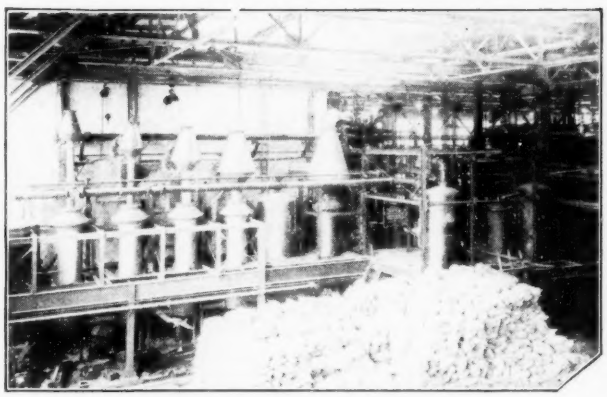


Important steps in the manufacture of paper from refuse lumber. *Upper left:* Specially designed car for transporting refuse lumber for paper pulp, and also for use as fuel in the mill. *Upper right:* Conveyor carrying chips to the boilerhouse to be used as fuel. *Lower left:* Chips for pulping are classified by screening over this battery of shaking sieves. *Lower right:* Screened chips being automatically weighed and sampled, while being moved from the storage bins to the digestors for conversion into the pulp from which kraft paper is made









Advanced stages in the manufacture of paper from wood pulp. *Upper left:* "Beaters" which reduce the size of the fibers after the digestive process. *Upper right:* The pulp emerges from this "board machine" in sheets 133 inches wide. This machine produces 100 tons of kraft paper a day. *Lower left:* This battery of motors provides the electric drive of the board machine. *Lower right:* Evaporator and dehydrator, enclosed to eliminate the obnoxious odor of the cooking liquor which usually makes a paper mill an undesirable neighbor

which the odorous gases are burned and rendered odorless.

Another usual source of odor is the recovery of cooking liquor, but at Longview a closed system of evaporators is used which concentrates the liquor so that it can be burned to "black ash" which reacts with the sodium sulfate fed to the furnace to form sodium sulfide "green liquor" which is used for the next digestion. Surplus heat from the furnaces is recovered in a waste heat boiler.

The paper-making equipment of the Longview Fiber Company consists of a 133-inch trim Black-Clawson board machine producing close to 100 tons of kraft test liner daily. This product is used as the inside and outside liners in corrugated shipping containers. It is made between 15 and 30 thousandths of an inch thick, depending on the type of container desired.

Recently a paper machine has been installed to produce 30 tons a day of lightweight wrapping and bag paper.

Sulfur in Gasoline

CORROSION of wrist pins in automobile engines using high sulfur fuel has been studied by S. H. Diggs of the Standard Oil Company of Indiana (Casper, Wyoming). The possibility of saving a very considerable amount of gasoline now lost in that part of the refining process which reduces its sulfur content, makes it important to find ways of using fuel in automobiles higher in sulfur and to this end it is necessary to know first just what action sulfur has in the engine. In reporting the results of his investigations to a recent meeting of the American Chemical Society, Mr. Diggs said in part:

"Excessive sulfur in gasoline does cause serious corrosion of moving parts within the crankcase, especially in cold weather and when frequent stops are made.

"There is no evidence that such corrosion occurs in warm weather or to any great extent on cars or parts that are kept continuously running during the day and in heated garages at night.

"There is no evidence to indicate that anything other than sulfur in the gasoline is to blame. Sulfur combined in the lubricant is not to blame except in so far as it may actually be burned in the cylinder.

"The amount of corrosion is disproportionately greater for high-sulfur than for low-sulfur fuel. This may be explained on the following grounds: The crankcase oil contains small amounts of material which will neutralize the sulfuric acid. In the best of conditions, crankcase oil, after a few hours' use, always shows some traces of finely divided iron and when used on dirt roads contains some road dust which is usually alkaline, often consisting essentially of carbonate of lime. If the amount of sulfuric acid formed is insufficient to react with finely divided iron and road dust, no injury results to the sclid metal parts. Therefore, a certain small amount of sulfur in gasoline is not injurious. When the amount of acid formed in the crankcase becomes greater than that which can be neutralized by the finely divided iron and road dust, corrosion soon begins.

"From these tests, it is evident that a sulfur content of 0.040 percent does no harm, that 0.151 percent sulfur does appreciable harm, and that 0.458 percent sulfur does very great harm. Just where to draw the line is hard to say. It is probable that conditions in these experiments were decidedly more severe than are usually met in the actual operation of an automobile. It is also obvious that the condition of the car as regards tightness of piston rings is a material factor, as well as the type of bearings. It would seem, however, from the data given that 0.100 percent would be a fair dead line. No doubt a lower sulfur content is desirable, but it is probable that this amount would cause no appreciable injury; on the other hand it seems very certain that 0.200 or 0.300 percent sulfur would cause very serious damage to a car operated intermittently in cold weather. As weather conditions and the way the car is used vary so greatly, no exact figure can be given for the maximum allowable sulfur."

Possibilities in redesign of engines to utilize high sulfur gasoline have been studied by H. C. Mougey of the research staff of the General Motors Corporation, (Detroit). His conclusions are stated in part as follows:

"It has been estimated that if the oil industry could raise the sulfur limit of gasoline from 0.10 percent to 0.30 percent, a saving of 50 million dollars per year in refining costs would be possible. It is recognized that the cause of corrosion in automobiles is water formed by the combustion of the fuel, and that the corrosion effect of this water is greatly increased if it is con-

(*Please turn to page* 83)

Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects; and Where to Get Them

A Survey Service

THE editor's aim in beginning this new department is to present compendia of bulletins, papers, et cetera, on a wide variety of researches and studies. It is intended as a guide to publications that are pertinent to vital problems, authoritative, and timely. It is planned to make this department particularly helpful to the busy executive who desires certain information but does not know where to get it.

Of the many publications of this nature that reach the editor's desk daily, only those that have, obviously, a wide appeal will be listed here, and these will be considered solely on their merits. Requests for publications mentioned, should always be addressed to the publisher or distributor — not to SCIENTIFIC AMERICAN.

The Editor.

Administration

ANNUAL REPORT OF THE GOVERNOR OF THE PANAMA CANAL FOR THE FISCAL YEAR ENDING JUNE 30, 1928, contains both detailed statistics and general information relative to the Panama Canal and the Canal Zone. Many illustrations are included in this 134-page report, with varied statistical data relating to operations and maintenance, administration, services rendered and net revenue, traffic through the canal, and present conditions in the Canal Zone (to June 30). *Superintendent of Documents, Government Printing Office, Washington, D. C.—20 cents.*

THE LEAGUE OF NATIONS, CARTELS, AND THE TARIFF, a paper by Mr. A. Cressy Morrison reprinted from the *Mining Congress Journal* of March, 1927. In this 14-page commentary an unofficial observer at the Geneva Economic Conference (1927) presents the case against internationalism and a defense of the present American policy of a high protective tariff. After a brief analysis of the international cartel, the writer compares modern European industry with American industry under our anti-trust laws. *Superintendent of Documents, Government Printing Office, Washington, D. C.—Gratis.*

A STANDARD CITY PLANNING ENABLING ACT (BUILDING AND HOUSING PUBLICATION NUMBER 11) has just been published by the Bureau of Standards, in response to many requests for a standard act which might be used in various states in drafting city planning legislation. *Superintendent of Documents, Government Printing Office, Washington, D. C.—15 cents each.*

CIVIL AERONAUTICS is a 178-page memorandum on legal aspects of aerial navigation, which also contains an historical sketch of the legislative history of the Air Commerce Act of 1926. The present compilation is a revision of the 1923 edition of Law Memoranda Upon Civil Aeronautics. *Superintendent of Documents, Government Printing Office, Washington, D. C.—Gratis.*

Agriculture

PEACHES (BULLETIN NUMBER 32, COMMODITY PRICES IN THEIR RELATION TO TRANSPORTATION COSTS). A 20-page bulletin of statistical data on production, prices, freight rates, markets and profits in the peach industry. *Bureau of Railway Economics, 1024 Transportation Building, Washington, D. C.—Gratis.*

ANNUAL REPORT OF THE NEW YORK STATE AGRICULTURAL EXPERIMENT STATION describes the experiments under way at the Geneva station. The report covers many investigations, including those dealing with soil fertility, feeding and breeding experiments, bacteriological problems of sanitary milk production and of food spoilage, diseases and insect pests of fruits and vegetables, dairy herd management, and studies with new fruit and vegetable varieties. *New York State Agricultural Experiment Station, Geneva, N. Y.—Gratis.*

Electricity

THE ELECTRICAL EQUIPMENT MARKET IN THE NETHERLANDS AND BELGIUM (TRADE INFORMATION BULLETIN NUMBER 578) has just been published by the Department of Commerce. The bulletin outlines the demand for electricity, cost, consumption, local manufacture of equipment, exports and imports of these two countries. *Superintendent of Documents, Government Printing Office, Washington, D. C.—Ten cents each.*

ELECTRIC LIGHT AND POWER IN THE UNITED STATES. The report of the rate research committee of the National Electric Light Association presents comparisons between the rates charged by municipal and private power plants. This 51-page report contains many charts and graphs, and an extensive bibliography on electrical rate making with special reference to analysis of costs and the classification of customers. *National Electric Light Association, 420 Lexington Avenue, New York City.—75 cents each. (50 cents to members of the N. E. L. A.)*

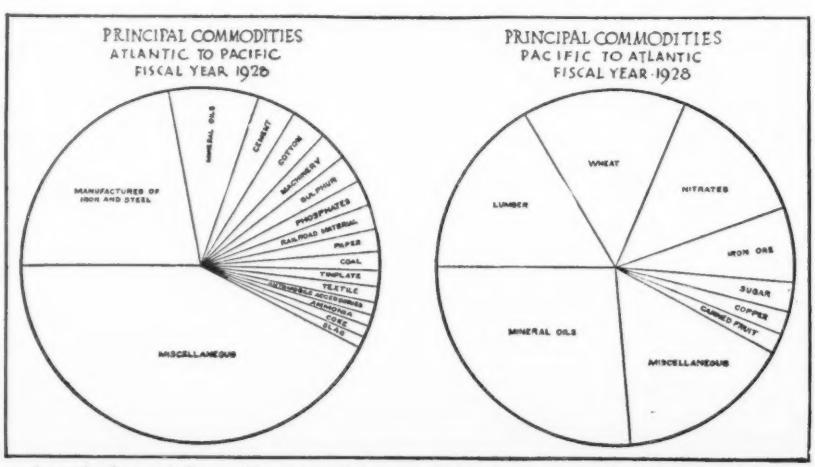
HOW TO BEGIN THE APPLICATION OF ARC-WELDING IN PRODUCTION MANUFACTURING, a 32-page supplement to the book "Arc-Welding—The New Age in Iron and Steel," contains specific and definite information on arc-weld design. The supplement is illustrated with drawings and photographs showing new designs adapted to the use of arc-welded construction in manufacturing. *Lincoln Electric Co., Cleveland, Ohio.—50 cents.*

Chemistry

INDUSTRIAL CHANGES DUE TO CHEMISTRY. A 20-page paper by Dr. Edw. R. Weidlein, Director of the Mellon Institute of Industrial Research, and President of the American Institute of Chemical Engineers. This paper provides a review of the major changes that have taken place in industry as a result of discoveries based on chemical research. *Mellon Institute of Industrial Research, Pittsburg, Pa.—Gratis.*

ITALIAN CHEMICAL INDUSTRY (TRADE INFORMATION BULLETIN NUMBER 577) deals with the progress made by the chemical industry in Italy since the World War. This bulletin sets forth in detail the economic and commercial features of the Italian industry, with production and con-

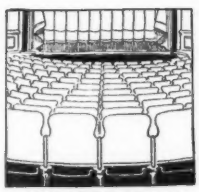
(*Please turn to page* 86)



A typical graph from the annual report of the Governor of the Panama Canal

This *grainless* wood offers new profitable opportunities for industrial progress

Each day new uses are being revealed for this product, because of its unusual workability, uniform strength, high resistance to moisture and other astounding advantages. Write today for a generous sample—sent free—and test for yourself its remarkable possibilities.



THEATRE SEATS

Industrial America . . . quick to grasp the importance of a product that would bring about significant manufacturing improvements and substantially lower operating costs . . . has already uncovered startling uses for Masonite Presdwood, the grainless wood board.

This easily worked material is made of genuine wood, torn apart and put together again without chemicals or any other foreign binders. It does not damage tools and will not crack, check, split or splinter. It is absolutely grainless.

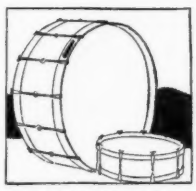
Presdwood cannot be destroyed by moisture and has a remarkable resistance to sudden changes in temperature. It is practically immune from warping, shrinking, swelling or buckling.

And when you have proved these facts for yourself, you will quickly realize why industry after industry has turned to it to reduce costs, improve a product or speed up production

There is little waste with Presdwood. It is easily handled. It can be used on any woodworking machine; it can be cut out, punched, die cut and scraped. It is perfectly smooth on the face side and requires no paint to withstand the elements.

New uses discovered daily

Each day new uses are being discovered for this remarkable product. Each day enthusiastic letters of praise are being received from a wide range of industries.



DRUM SHELLS

Motor boat hulls, truck bodies, tension boards for radio speakers, portable billiard tables, toys, bedroom screens and fire screens, store fixtures and table tops, show window flooring and show cases, interior finish and office partitions, radio boxes, paneling, closet lining and display booths, breakfast nooks and kitchen cabinets, signs and cut-outs of all kinds, suggest some of the many and varied uses of Presdwood.

Several railroads are now using Presdwood as paneling in their new Pullman cars. A box maker turned to Presdwood after a box of this material had withstood being dropped 1942 times when a similar box of conventional material failed after 871 drops. The Chicago Art Institute is using Presdwood as a backing to protect rare works of art. Campers' tables, safety wheels for bathing beaches, bread boxes, dust arresters for journal boxes and lining for elevator and ventilator shafts, suggest more of the seemingly endless uses of this grainless wood board.

Send for your sample

If discovering new and profitable applications for a product of unusual workability intrigues you, do not fail to write today for your free, generous sample of Presdwood. The chances are it will enable you to learn how to make a worthwhile improvement in some product.

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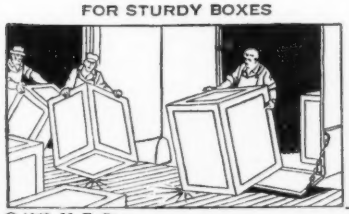

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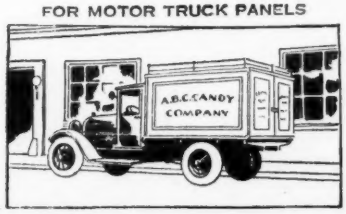

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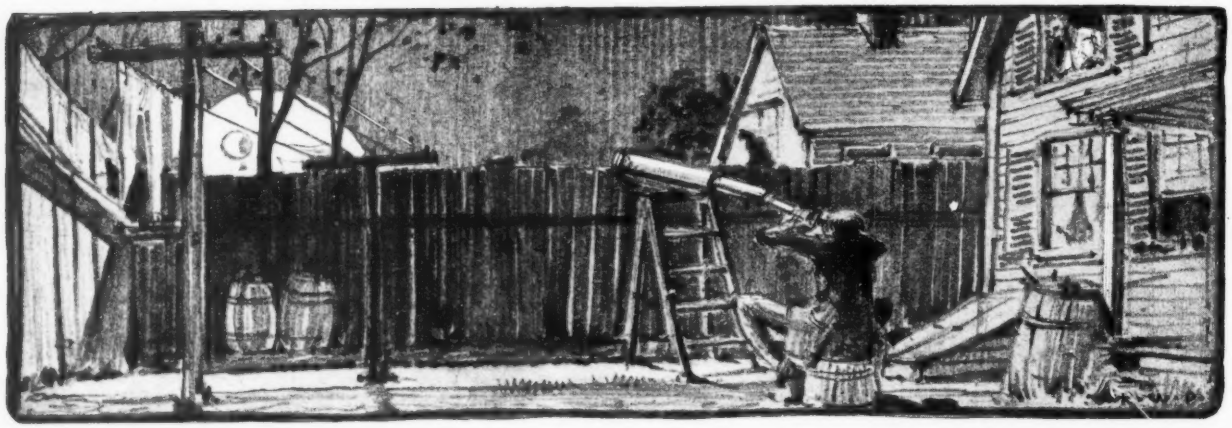
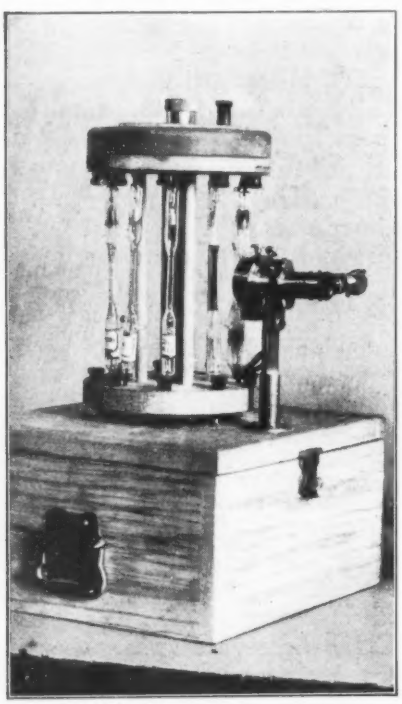


The Back Yard Astronomer

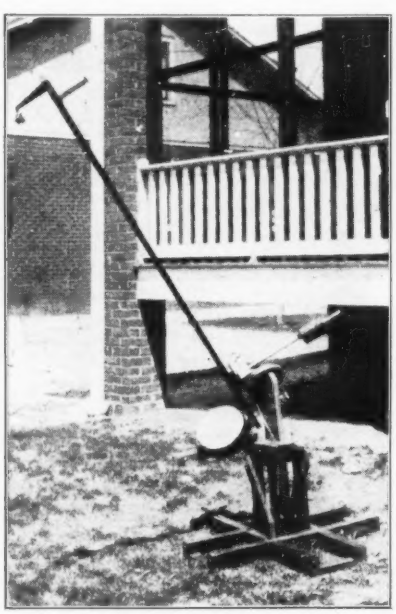
A Department Devoted to Interests of the Amateur Telescope Maker

"I HAVE visited Dr. Hale's laboratory here in Pasadena, California, several times to watch the progress and development of his amateur spectrohelioscope," says F. M. Hicks, 1315 South Oakland Avenue, that city. "The wonderful results he obtains by this instrument have impressed me with the desirability of trying to give the student and interested public a picture that will make them understand star spectra somewhat as he has accomplished this for sunspots.



The Hicks Spectra Demonstrator with its protecting case removed

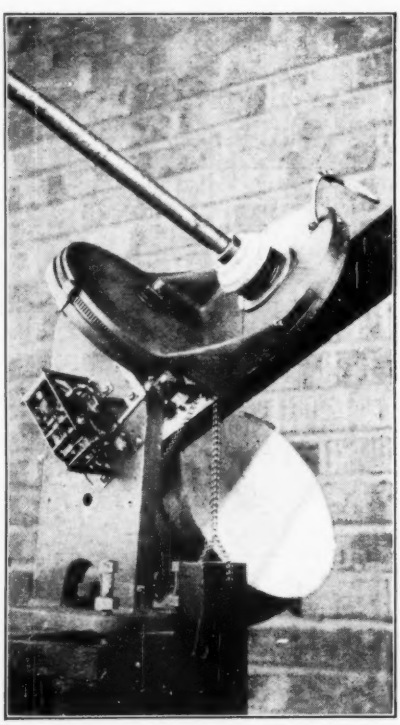
"The average man may know in a vague, general way that much of the astronomer's knowledge of the stars comes by way of the spectroscope, but the black and white spectrum lines as they are generally shown mean little to him. The accompanying photograph is the result of trying to bring these spectrum lines to him in color and action. By means of this instrument, which I have called the 'spectra demonstrator,' one can see and compare the spectra of a number of gases and metals—a veritable picture show in colors—and it will help the amateur or student to realize that when the astronomer with his telescope sees these same lines and colors in a star, he knows that the star contains the particular gas or metal that they have been looking at in this instrument.



Mr. Cooke's telescope of the "spinal column" or tubeless type

"Then, if we tell him further that the broad spectrum lines of one gas show the movement of gas in molecules, while the narrow spectrum lines in the adjoining tube which he sees at the same time, show the result of the knocking off of electrons from the gas atoms, he will not only obtain a beautiful sight—for the colors are wonderful—but he will begin to get some idea of electrons, atoms, and molecules, and their action in matter. This sort of a 'moving-picture show' interests and fascinates not only the man who knows little of physics and astronomy, but the student also.

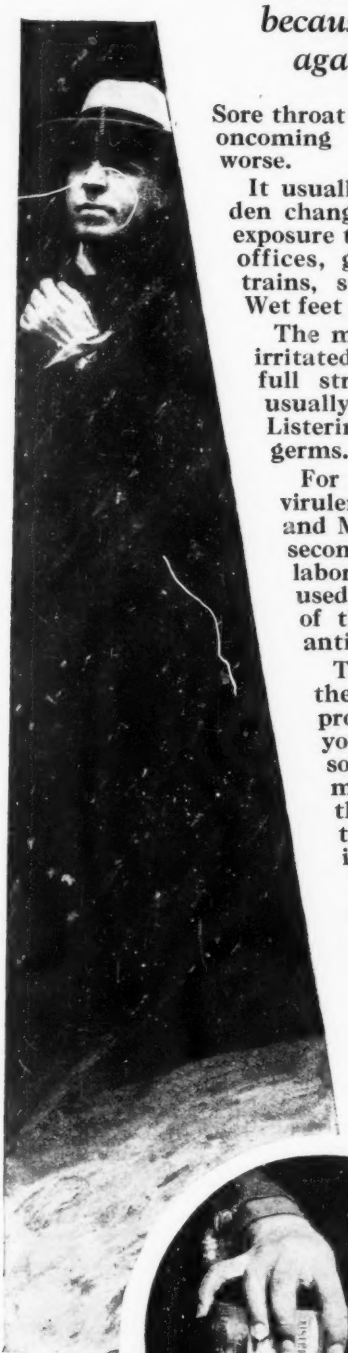
"The instrument is complete, self-contained, is suited for both individual as well as class room use, and is operated by plugging in on the ordinary house light current. It contains eight vacuum tubes filled with gases, such as oxygen, hydrogen, helium, mercury, and so on; a holder for an open arc, to show spectra of metals such as iron, copper, salts, and so on; one 4000-volt



A detailed view of the ingenious clock drive of the telescope at left

After exposure—avoid Sore Throat

LISTERINE



Checks it quickly because powerful against germs

Sore throat is a danger signal of oncoming trouble—a cold or worse.

It usually develops after sudden changes in temperature or exposure to others in overheated offices, germ-ridden railway trains, street cars and buses. Wet feet also encourage it.

The moment your throat feels irritated, gargle with Listerine full strength. Sore throat is usually caused by germs—and Listerine full strength kills germs.

For example, it kills even the virulent B. Typhosus (typhoid) and M. Aureus (pus) germs in 15 seconds, as shown by repeated laboratory tests. Yet it may be used full strength in any cavity of the body. Indeed, the safe antiseptic.

The moment Listerine enters the mouth it attacks the disease-producing bacteria that cause you trouble. And unless your sore throat is a symptom of some more serious disease, calling for the services of a physician, Listerine will check it in an amazingly short time.

For your own protection, keep a bottle in home and office. It's an investment in health. Lambert Pharmacal Company, St. Louis, Mo., U. S. A.

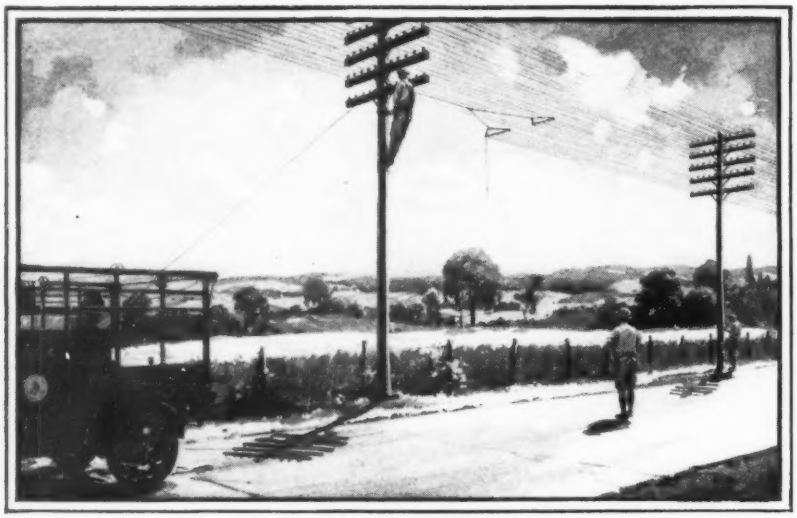
To *escape a cold* *use Listerine this way:*

You can materially lessen the risk of catching colds by rinsing the hands with Listerine before each meal, the way physicians do. The reason for this is obvious:

Listerine attacks the germs of cold on the hands, thus rendering them harmless when they enter the mouth on food which hands have carried. Isn't this quick precaution worth taking?

"GREAT!"

men say. They're enthusiastic about Listerine Shaving Cream. You will be also when you try it. So cool! So soothing!



The U.S.A. is only a few minutes wide

An Advertisement of the American Telephone and Telegraph Company

In the gold rush year of '49 a stagecoach succeeded in crossing the continent in about three months. Two decades later, for the first time, an unbroken stretch of railroad lay from New York Harbor to San Francisco Bay, and America was seven days wide. Today, by telephone, that entire width is only a matter of minutes. And these few minutes represent a round trip, taken in the ease of office or home.

The Bell System is ever busy reducing the width of America and the distance between cities. For example, during 1929 it will add to its lines nearly 2,000,000 of the new permalloy loading coils for correcting and maintaining the speeding voice currents.

Seven thousand miles of new intercity cable, $40,000,000 worth, will be added to the System to protect against storms and other slowing up influences.

In the last five years 350 major improvements, as well as thousands of others whose aggregate importance mounts high, have been made in telephone central office equipment.

Improved operating practices have eliminated the necessity of your "hanging up" and being called back in 95 per cent of toll and long distance calls, adding new speed and ease to out of town calling. You hold the wire and the operator does the rest.

Since New Year's Day, 1927, the average time for completing all out of town calls has been cut 35 per cent and at the same time the per cent of error has been further materially reduced.

There is no standing still in the Bell System. Better and better telephone service at the lowest cost is the goal. Present improvements constantly going into effect are but the foundation for the future's greater service.

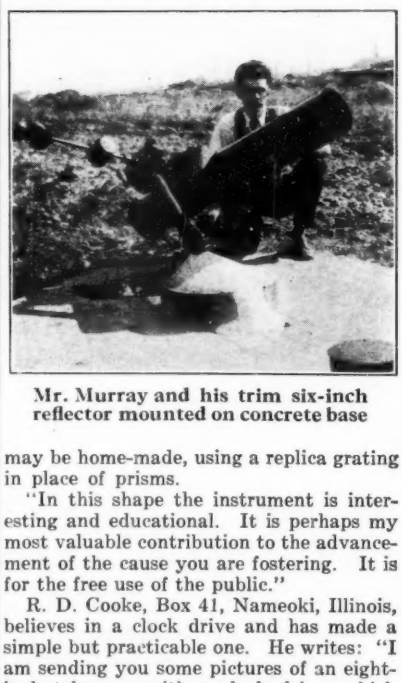
"THE TELEPHONE BOOKS ARE THE DIRECTORY OF THE NATION"

transformer and one 10,000-volt condenser, both properly insulated for safety; and one direct-vision hand spectroscope, with wavelength scale and device to show spectra of two gases at the same time, so that the lines and colors may be compared and examined in detail.

"The base box is 12 inches square, six inches high. On it is placed a revolving frame carrying the vacuum tubes. The spectroscope is held stationary in a socket in the base box, while the tubes revolve; thus giving a succession of spectra so they can be easily examined and compared.

"The instrument will be put up in a complete unit—a precision laboratory apparatus. It will be built by the same firm which is building the Hale amateur spectrohelioscope. The vacuum tubes may be purchased separately.

"The instrument has been seen and examined by some of the officials of both Mt. Wilson Observatory and California Institute of Technology and has received their warm approval. While it is not a cheap affair it may be duplicated in an inexpensive and simple form by the amateur, using a Ford coil for a transformer and a condenser made from less than a dollar's worth of tinfoil and glass; the spectroscope



Mr. Murray and his trim six-inch reflector mounted on concrete base

may be home-made, using a replica grating in place of prisms.

"In this shape the instrument is interesting and educational. It is perhaps my most valuable contribution to the advancement of the cause you are fostering. It is for the free use of the public."

R. D. Cooke, Box 41, Nameoki, Illinois, believes in a clock drive and has made a simple but practicable one. He writes: "I am sending you some pictures of an eight-inch telescope with a clock drive, which may be of interest to some of your readers. I am extremely pleased with the way it works.

"The driving clock is the movement of a dollar-and-a-half alarm clock and serves merely to control the speed. The main source of power is the weight operating over a sprocket on the worm shaft. The large gear floats on the center pin and turns continuously. The casting carrying the hour circle rests on the edge of the gear and is carried along with it, except that it may be moved by hand to any position desired. As soon as the hand releases it, the clock begins to carry it along.

"Since making the pictures I have mounted a flashlight bulb under the reading glass for illuminating the declination circle.

(*Please turn to page* 85)

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Industries From Atoms

(*Continued from page 77*)

taminated with acids resulting from the burning of the sulfur in the fuel.

"Crankcase ventilation and control of the jacket-water temperatures by thermostats have been recommended to eliminate the condensation of water from the burning of the fuel and thus combat this corrosion. Records of tests and of performance in service in the hands of the public of engines equipped with such devices and operated on fuels of different sulfur content show that the thermostats and ventilators are of very great value in combating corrosion. However, it is concluded that, inasmuch as a large number of cars are not so equipped, an increase in the sulfur content of motor fuel at the present time is not in accord with the best interests of the automobile industry and the public."

Soap Used in Oil Refining

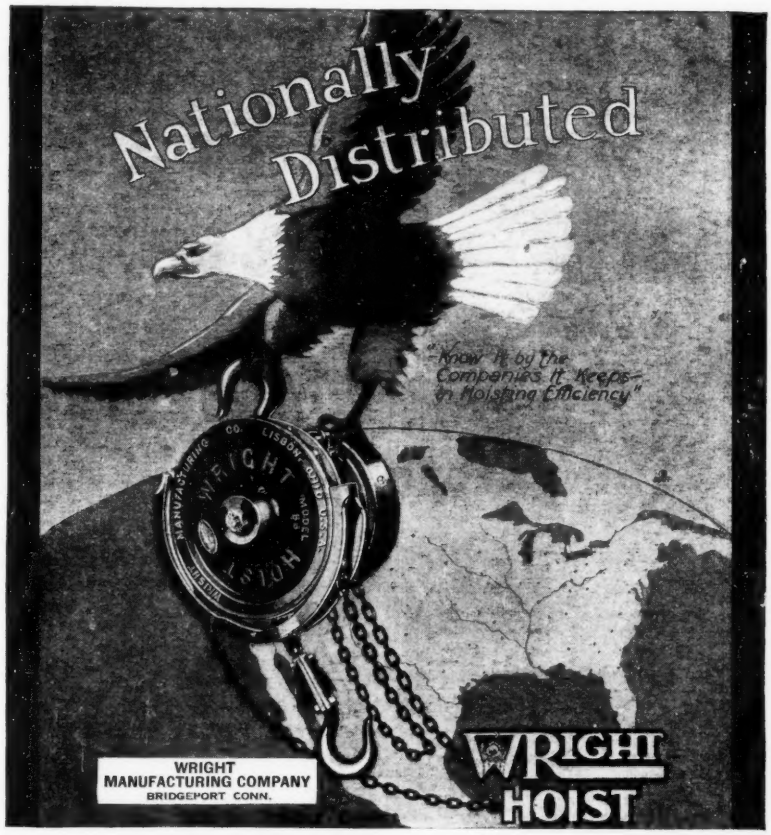
THE advertising man has convinced us that soap will do all sorts of splendid things, from floating to preserving a schoolgirl complexion, but it remained for a German chemist, Prof. Fritz Schwartz, to discover that soap makes an excellent reagent in the refining of mineral oil. The impurities in the distillates do not enter the soap solution but the soap is precipitated together with the impurities. The originator has compared this precipitation with the sulfuric acid and other processes and has found, especially in the case of transformer oils, that it is characterized by oils of a very slight resin formation.

Another substance developed abroad of use in mineral oil refining is "talloel" which is derived as a by-product in the Scandinavian cellulose industry. Apparently, the same principle is involved, since the caustic treatment of coniferous wood in paper manufacture produces a vegetable soap for which no very general use has heretofore existed. Such "soap" solutions should be cheaper for refining purposes than soap made from oleaginous fats.

"Little Bugs and Lesser Bugs" Succumb to New Insecticides

IT used to be quite sufficient to know that certain substances would kill undesirable insect pests. But nowadays chemists are watching the death throes of all sorts of bugs to find out just why some insecticides are more effective than others. This curiosity is not inspired by any sympathy for the insect victims but is merely the chemists' way of developing better insecticides.

Fluorides and fluosilicates have been shown to upset the respiratory metabolism of insects so seriously that their interest in the pantry shelf and the kitchen sink is abruptly terminated. Dr. David E. Fink of the Department of Zoology at the University of Pennsylvania, in reporting his investigations on the effectiveness of fluorine and arsenic insecticides at a recent meeting of the American Chemical Society, said, "Fluorine, like arsenic, is found in the normal tissues of plants and animals. The effect of feeding or injecting lethal doses of fluoride and fluosilicate compounds on the respiratory metabolism of insects, is to depress the carbon dioxide output more than the oxygen consumption, which is the reverse of the effect upon the gaseous



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34 West 28th Street,

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To the Editor December 1, 1928

Dear Sir:

For many years I have been given the chance, through your columns, of reaching your readers with a plea for the wives and little children of the prisoners at Christmas time. This glorious holiday season that means so much in happy homes is a day of added loss and sadness to them.

The Volunteer Prison League seeks to dispel these shadows by sending such gifts as will not only make it a gala day, but add solid comfort in the cold winter months to come. In addition to Christmas cheer and toys, we send warm new clothing and shoes for the little feet that must tramp to school through mud and snow and which, but for our gifts, would be poorly shod.

The prisoners themselves in all our Institutions will be remembered by the State with Christmas fare and some kind of celebration, but their helpless dependents who bear the heavier burden are often forgotten.

Will the readers of this message help me send aid to these innocent sufferers? We try to make every dollar go as far as possible. I might add that the Volunteers of America is a duly incorporated organization, that our accounts are carefully kept and audited, and receipts sent for every gift.

We shall be most grateful for all donations of money, clothing and toys. They should be sent to Mrs. Ballington Booth, the Volunteers of America, 34 West 28th Street, New York City.

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exchange obtained with arsenicals. These chemicals do not affect respiration to as great an extent as do the arsenicals. Whereas the former depress the oxygen consumption and carbon dioxide output 11 and 13 percent respectively, arsenicals depress them 36 and 40 percent respectively, indicating that arsenicals are from four to five times as toxic to respiration as the fluorides and fluosilicates. No marked difference in toxicity between fluorides and fluosilicates appears to exist when neutral solutions are employed, if we judge from their effects on respiratory metabolism of insects.

"There appears to be an affinity of fluorine for the calcium of the tissues; experimentally this may be demonstrated by making less toxic a lethal dose of fluoride or fluosilicate by a previous or simultaneous injection of a dose of calcium chloride. The effect of fluorine on the tissues is probably not so much the precipitation or removal of calcium ions from the cells (under normal conditions such losses may be replaced by the body) as the replacement of calcium by fluorine as a cell constituent."

Rubber Used as Binder for Foundry Cores

SAND cores used in the foundry industry have played a very important part in the development of the art of molding and in the reduction of molding costs. The removal of cores from the casting, however, is an expensive, laborious, and dusty task, often requiring the use of a pneumatic chisel or other tools. Cracked castings, due to hard cores which do not crush as the metal solidifies are sources of loss to foundries.

Recently there has been developed at the United States Bureau of Standards a new foundry core sand binder in which rubber is used as the basis of the core binder. The outstanding advantages are: (1) The cores crush readily, falling to loose sand of their own accord, so that the core sand may be poured from the casting instead of having to be dug out: (2) The cores have greater strength than a greensand core and extend the range of jobs to which a readily crushed core may be applied: (3) The cores are not oven baked; they are merely air-dried: (4) The cores are of high permeability and show remarkable freedom from blowing.

The new rubber core binder consists essentially of a solution of unvulcanized rubber in gasoline. The amount and type of rubber binder used in making cores depend upon the type of core sand, the size of the core, and the metal to be cast around it. The new binder has proved successful in producing sand cores for castings of lead, tin, zinc, brass, phosphor-bronze, bronze, aluminum, iron, and steel; in fact, it has been found satisfactory for almost all foundry cores.

Sawdust and Soft Sand Cleans Floors

A SWEEPING compound for linoleum, concrete and cement floors, made from a special grade of sawdust and soft sand which will not injure any floor has recently been put on the market. A consistent use of this preparation, the manufacturer claims, will soon brighten the dullest floor, keep the dust down and make the floor look as if it were scrubbed daily.

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The Backyard Astronomer

(*Continued from page 82*)

"To show the accuracy of the mechanism I sighted on the nebula in Orion, and then went into the house for nearly an hour. Going out again I found the nebula exactly centered in the field. I am tempted to try some photography with the telescope and would be glad to hear from anyone who has done any work of this kind."

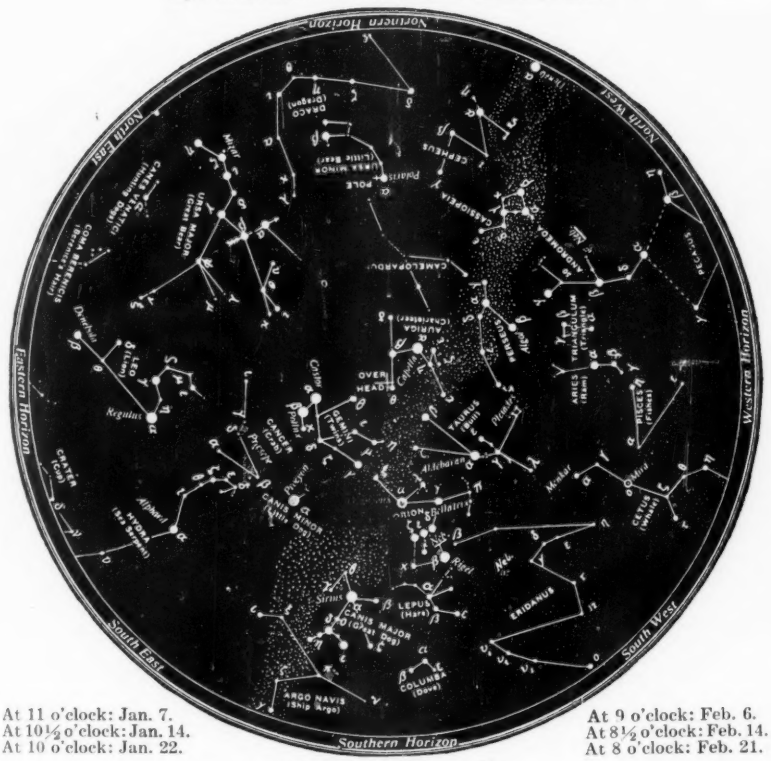
Martin G. Murray, a post office clerk at Huntington Beach, California, writes: "As soon as 'Amateur Telescope Making' was off the press, I purchased a copy. However it was not till the latter part of 1927 that I had the opportunity to begin work on my telescope. I am especially interested in the study of sunspots, and have just made an attachment that makes it possible to chart the spots. I am well pleased with the entire instrument and am very grateful for all help received through the SCIENTIFIC AMERICAN. I am enclosing a photograph."

¶ The Telescope Editor has just returned from an excursion in Europe, which included visits to several places of astronomical, and particularly telescope making, interest. Several large optical shops in Great Britain and Germany were visited. No real T.N. should leave London without making a sacred pilgrimage to Burlington House to see Newton's original reflector with its tiny mirror, nor fail to go to Florence where, at the Museum of Physics and Natural History, he may approach within close view of Galileo's famous original telescopes.

—*A. G. I., Tel. Ed.*

The Heavens in January

By PROF. HENRY NORRIS RUSSELL, Ph.D.



At 11 o'clock: Jan. 7.
At 10½ o'clock: Jan. 14.
At 10 o'clock: Jan. 22.

At 9 o'clock: Feb. 6.
At 8½ o'clock: Feb. 14.
At 8 o'clock: Feb. 21.

At 9:30 o'clock: January 29.

NIGHT SKY: DECEMBER AND JANUARY

MERCURY is an evening star all through January and may be best seen about the time of his greatest apparent distance from the sun, on the 22nd. At this time he is near perihelion, so that he looks nearer to the sun than usual. But to make up for this he is brighter. He is in Capricornus, 15 degrees south of the equator and should be easily visible in the fading twilight a little before 6 P.M.

Venus is also an evening star, but more than twice as far from the sun. By the end of the month she remains in view till 9 P.M. and is by far the most conspicuous object in the evening sky.

Mars, although receding from the earth, is still very bright. He is on the border between Torus and Gemini, in 26 degrees north declination. He rides very high in the evening sky and remains in sight till after 5 A.M.

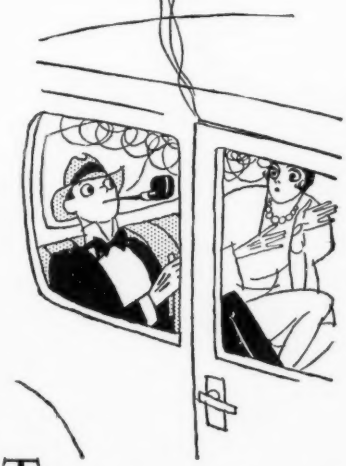
Jupiter is in quadrature, 90 degrees east of the sun on the 22nd and counts as an evening star after that date, although he does not set till shortly after midnight.

Saturn is a morning star in Sagittarius, rising about 5 A.M.

Uranus is past quadrature, but observable in the early evening, and Neptune is visible in the morning.

The moon is in her last quarter at 2 P.M. on the 2nd; new at 7 P.M. on the 10th; in her first quarter at 10 A.M. on the 18th, and full at 2 A.M. on the 25th. She is nearest the earth on the 23rd and farthest away on the 7th. As she sweeps around the heavens she comes into conjunction with Saturn on the 8th, Mercury on the 12th, Venus on the 14th, Uranus on the 16th, Jupiter on the 18th, Mars on the 22nd, and Neptune on the 26th. None of these approaches is particularly close.

Their last ride together



THERE'S more than one reason why girls walk home. There's more than one bachelor who wouldn't have to stay that way if only some one would tell him about Sir Walter Raleigh. Oh well, for that matter, *we'll* tell him. It's milder, men, a lot milder, and it will do a lot to make that strong old briar of yours fit to enter decent company.

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THE PHASES OF THE MOON ARE GIVEN IN THE TABLES.
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NOVEMB
OCTOBER
SEPTEMBER
AUGUST
JULY
JUNE
MAY
APRIL
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Current Bulletin Briefs

(*Continued from page 78*)

sumption statistics. Similar reviews available on *Germany* (*Trade Information Bulletin Number 532*) and *England* (*Trade Information Bulletin Number 545.*). *Superintendent of Documents, Government Printing Office, Washington, D. C.—Ten cents each.*

Health and Safety

HEALTH HAZARDS IN CHROMIUM PLATING reports conclusions and recommendations resulting from a recent survey. The report indicates that a real hazard exists in chromium plating, but by the practice of suitable measures, the danger can be entirely eliminated. Specific recommendations are given for counteracting the menace. *Bureau of Standards, Washington, D. C.—Gratis.*

THE VALUE OF INERT GAS AS A PREVENTATIVE OF DUST EXPLOSIONS IN GRINDING EQUIPMENT. Although the investigations were conducted in feed-grinding equipment, the results suggest many possible uses for inert gas as a fire preventive and fire fighting medium. *United States Department of Agriculture, Washington, D. C.—Gratis.*

EMPLOYMENT OF WOMEN AT NIGHT, presents the history of the struggle against the system, with an appeal for better state legislation to regulate night employment of women. *Women's Bureau, Department of Labor, Washington, D. C.—Gratis.*

SPRAY COATING—ITS HAZARDS AND SAFEGUARDS, is a helpful booklet discussing the rapidly expanding lacquer spray industry. The treatise deals with the history of lacquers, health hazards, precautions for safeguarding workers, and steps for the protection of property by various emergency appliances. *Department of Public Relations, Hartford Accident and Indemnity Company, Hartford, Connecticut.—Gratis.*

Mining

COPPER IN 1926, a 57-page general report just published by the Bureau of Mines, is a survey of the entire copper industry in the United States during 1926. Detailed reports are given covering operations in each producing region (including Alaska), and general statistical data on other copper producing countries of the world. *Superintendent of Documents, Government Printing Office, Washington, D. C.—Ten cents.*

GEOPHYSICAL PROSPECTING: SOME ELECTRICAL METHODS (BUREAU OF MINES TECHNICAL PAPER NUMBER 434) contains 34 pages, with many illustrations, describing equipment and proceedure used in connection with methods being practiced in prospecting for ores with electrical apparatus. *Superintendent of Documents, Government Printing Office, Washington, D. C.—Ten cents.*

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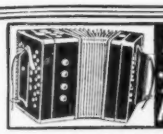

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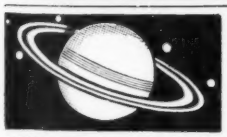

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This bulletin describes two amplifiers admirably adapted to television work. *International Resistance Company, 2006 Chestnut Street, Philadelphia, Pa.—Gratis.*

RADIO ACOUSTIC POSITION FINDING, SPECIAL PUBLICATION NUMBER 146. This 62-page bulletin is illustrated with photographs and drawings showing equipment used in conducting modern coastal surveys. *Superintendent of Documents, Government Printing Office, Washington, D. C.—20 cents each.*

Transportation

RAILWAY STATISTICS OF THE UNITED STATES OF AMERICA FOR 1927, COMPARED WITH THE OFFICIAL REPORTS FOR 1926 AND RECENT STATISTICS OF FOREIGN RAILWAYS, is now available. This 154-page book presents comparative data under many headings including mileage, equipment, employees, capitalization, costs, earnings, expenses, and accidents. *Bureau of Railway News and Statistics, First National Bank Bldg., Chicago, Ill.—Gratis.*

THE EVOLUTION OF MODERN INDUSTRY AND ITS RELATION TO TRANSPORTATION. Reprint of an address by Geo. D. Ogden, Traffic Manager of the Pennsylvania Railroad. In this 18-page paper, the "migration of industry" is discussed, showing effects of railway freight rates, cheap water transportation and shifting centers of population on industries in various sections of the country. *Policyholders Service Bureau, Metropolitan Life Insurance Co., 1 Madison Avenue, New York City.—Gratis.*

Miscellaneous

AIRPORTS AND LANDING FIELDS (AERONAUTICS BULLETIN NO. 5) lists the existing and proposed aviation fields of the United States, as of September 1, 1928. In this 10-page bulletin, landing fields and airports are listed alphabetically by states. *Office of the Secretary, Department of Commerce, Washington, D. C.—Gratis.*

PRACTICAL AIDS TO THE INDEPENDENT MERCHANT. Many of the problems with which the small merchant has to contend are analyzed in this 30-page bulletin, and suggestions for remedying them are given. A list of more comprehensive books and bulletins on Retail Store Problems, Cost and Commodity Studies, Packing and Transportation, Regional Surveys, Commercial Laws, et cetera, is included. *Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C.—Gratis.*

CONCRETE—ITS MANUFACTURE AND USE, is a non-technical treatise on up-to-date methods of preparing and handling Portland cement concrete. *Koehring Company, Milwaukee, Wisconsin.—Gratis.*

RUBBER ROADWAYS is an interesting booklet, well illustrated, showing various methods and materials used in building roads of rubber. *Rubber Roadways, Ltd., 4 Idol Lane, Eastcheap, London, E.C. 3, England.—Gratis.*

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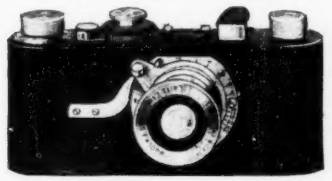

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"A LEICA Camera . . . allowed us to take records of our progress and photographs that would not have been possible with any of the other six cameras we had with us." *Fred Herz, Photographer and Expert Mechanic, The University of Michigan, Greenland Expeditions.*

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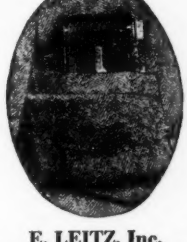

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The Scientific American Digest

(*Continued from page 69*)

The tomb was like the queen's in its plan, in its secrecy, and like the queen's in that it tunneled toward the sacred precincts of the temple.

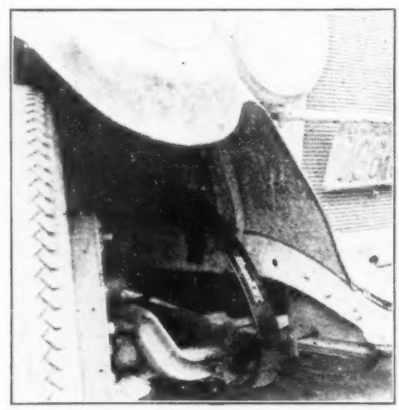
Senmut even went further and dared link his name with that of the ruler of Egypt. On the ceiling of his tomb was written in hieroglyphs a sentence in flowery Egyptian which in plain English contains the idea, "Long live the Queen of Upper and Lower Egypt (Hatshepsut) and the Chancellor, the Steward of Amon, Senmut."

But the ambitious architect never had the satisfaction of inhabiting his regal secret tomb. Hatshepsut and her officials were involved in political intrigues which ended in Thutmose III taking Hatshepsut's place as the ruler of Egypt. Senmut's downfall came first, the new excavations show, for his portraits in the tomb are mutilated, while Hatshepsut's are not disturbed.

"As soon as news arrived of the end of the Great Steward, orders were given to close up his presumptuous new tomb," Mr. Winlock states. "Workmen went down to the decorated chamber and smashed the faces of Senmut wherever they noticed them.

"Hastily gathering together bricks and stones at the mouth of the tomb they started to wall it up, but the work did not go fast enough, and before they had finished their wall they gave it up and raked down just enough dirt to cover over the doorway."

When the expedition entered the walled-up tomb, it found only one room had been decorated by Senmut's workmen before the downfall. Walls of the chamber were lined with hieroglyphics. The real gem of the room, however, is the ceiling which represents a chart of the heavens. This is pronounced one of the best and one of the earliest astronomical charts yet found, drawn by the most skilful penmen of the 15th century B.C.—*Science Service.*



The spring-action damper installed on the front axle of an automobile

Automobile Spring-Action Damper

SHOCK absorbers and spring-control devices of many kinds have been developed in past years in efforts to give cars better riding qualities. A new one that merits consideration because it utilizes an entirely new principle, has just come to our attention. It is the two-way shock absorber, manufactured by Charles M. Kearns, Beavertown, Pennsylvania, which damps the major movements of springs but allows free play of minor movements, during both compression and rebound.

The new absorber consists of a check spring, one end of which is bolted rigidly to the axle frame while the other end rests, in strong tension, on a felt covered bracket which is bolted to the chassis frame. This check-spring makes a sweeping curve outward from the axle, thence upward and back over the bracket.

When the main spring is compressed, the check-spring slides over and backward on the friction mat. Since the check-spring slides over under tension, the friction between it and the mat tends to retard the compression of the main spring.

On the rebound of the main spring, the retarding action is more effective than during compression. This is because the main spring must pull against the strong tension of the check-spring and also because the mat friction is again present.

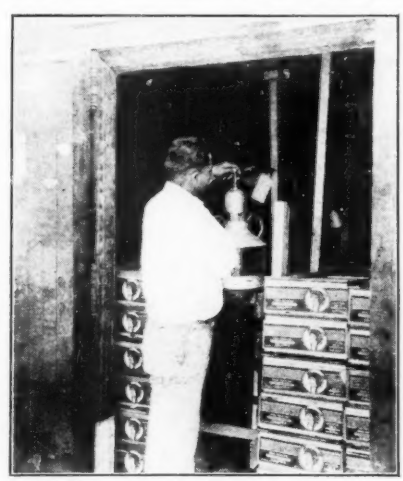
It is said that these new shock absorbers prevent side-sway.

Electricity Aids in Gassing Fruit Bugs

THE bugs and molds which infest refrigerator cars loaded with fruit will have to wear gas masks soon, if they would escape the effects of a device just placed on the market by the Ansul Chemical Company of California, Modesto, California. This device liberates gas which permeates the skin of the fruit and kills, within 20 minutes, all the larvae, bugs, and various fruit molds that would ordinarily damage the fruit during its shipment east.

Liquid sulfur dioxide is contained in a heavy steel cylinder under high pressure, and the killing gas is mixed with the air of the refrigerator car when a valve is opened in the neck of the container. The high pressure is attained by expansion, the cylinder being placed in a specially prepared container holding three gallons of water at a temperature of 140 degrees, Fahrenheit.

Some difficulty was at first experienced in attempting to design equipment for generating the heat in the water bath. The problem was finally solved by the use of General Electric immersion heating units.



Operator opening the valve of the gas container of the new fruit-bug gassing equipment. The released gas kills all bugs, larvae, et cetera

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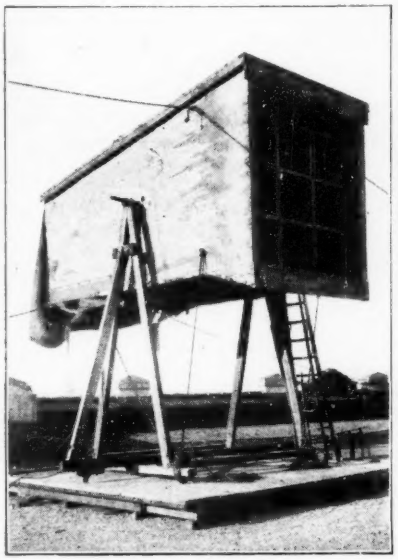
The new unit was recently given its first practical demonstration before a group of fruit shippers on the west coast, and their enthusiastic response is taken as an indication of an intensive campaign of bug and mold extermination soon to begin. California fruit shippers will have this equipment available for use this season to assist them in placing sterile fruits on the eastern markets.

Sound "Beam" Sending Horn

THE practicability of directing a beam of sound to a definite distant point was demonstrated recently when officers of the

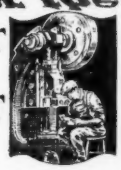


The roughly built but effective, experimental horn for sending a "beam" of sound, on the roof of the Victor Talking Machine building

United States Navy dirigible *J-4*, flying at 1500 feet over Camden, distinctly heard the voices of officials of the Victor Talking Machine Company, as well as a program of music and constant tone signals, projected to them by the recently developed super-directional horn mounted on the roof of a 10-story building at the Victor plant. Instead of the diffusion of waves customary when sound is broadcast, the new horn sent out a beam of sound which at all times was trained on the dirigible in flight, much as the beam of a giant searchlight would have been played on it.

Satisfactory results of the experiment indicate that an important step has been completed in removing the hazards of landing dirigibles, especially in time of fog, since the horn supplements the work of the radio beacon at a point where, because of short range, the beacon becomes ineffective and useless.

The horn, which was developed by S. T. Williams, Works Manager of the Victor Company, comprises a cluster of nine small-mouthed conical horn units, each carrying a powerful loudspeaker, joined into a single straight-sided mouth without the characteristic musical horn flare. The whole assembly makes up a rectangular box approximately eight feet square and 20 feet long, mounted on pivots and having rotating tracks permitting it to be pointed in any direction. It is expected that further tests will be made in the near future with the *Los Angeles*.

Stands Over the Under-Producer

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This new Press Counter will keep watch of the workman who's apt to lag and let his production sag. It will keep his record in front of him, and keep his mind on his *task*. It will make him responsible for a *better* showing. Subject to check-up at any minute.
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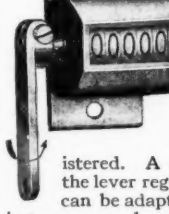
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Nitroglycerine and Nitroglycerine Explosives

By Phokion Naoum

AN error of statement was made in our listing of this work last month. The original is of date of 1923 but the translator, E. M. Symmes, has noted any changes or modifications of practice, particularly in the United States, up to 1928. $7.25 postpaid

Old Americans

By Ales Hrdlička

READERS of SCIENTIFIC AMERICAN who have enjoyed the author's articles will be interested in this study of the pioneer white stock in America, including a chapter on the future American type. Anything Dr. Hrdlička writes commands attention throughout the world and this is a particularly important contribution to the question of the mixture of races. $10.00 postpaid

Alexander Graham Bell

By Catherine Mackenzie

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By Katherine Helm

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Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Ideas Are Not Patentable

"THE law grants patents only for new things, not for new ideas."

So declares Judge Swan, of the Circuit Court of Appeals in New York, in the case of the Concrete Mixing and Conveying Company against the Powers-Kennedy Contracting Corporation. It is a remark which might well be memorized by inventors who have new and original ideas they wish to capitalize.

In the case which brought forth the remark of the judge which heads this item, the concrete company's patent included means for injecting air into the concrete at its entrance into the discharge outlet of the conveyor pipe. The Powers-Kennedy Corporation, defending the suit for infringement, maintained that the patent was invalid on the ground that it was anticipated by a system in which the concrete flowed by gravity through the pipe and then was subjected to air or steam pressure. In differentiating the old and new systems, the Court says:

"The physical change in the apparatus need be very little to sustain a patent. The only reason why a new use is not patentable is that the law grants patents only for new things, not for new ideas.

"While this machine discloses the idea of forcing concrete through a pipe by compressed air, whether it was practically operable may well be doubted. It would seem that a large quantity of the concrete, or at least the stones of which it is partly composed, would necessarily accumulate upon the flat bottom of the chamber. In any event, it was very different from McMichael's (the inventor's) device, which injects air into the concrete at its entrance into the discharge outlet. It cannot be regarded as an anticipation."

Profits In Cinders

WHEN notices went out recently to a large number of licensees of various processes for using cinder and ashes in the manufacture of concrete block, asserting that they were violating patent rights of Crozier-Straub, Incorporated, attention was drawn to the quick, widespread and profitable use now being made of a by-product which heretofore has been considered a waste rather than an asset.

The patent in question was issued January 16, 1917, to Francis J. Straub for a building block in which the whole product, cinders and ash, half burned and wholly burned, lumps and dust, were ground and rolled together. Of the merit of the product, Judge Wooley, in the Circuit Court of Appeals for the Third Circuit, says:

"All blocks are more or less soundproof but Straub's is more soundproof than others with hard aggregates, doubtless for the reason that instead of being a solid mass as when made of sand or stone aggregate, it is porous, containing myriads of cells; it permits nails to be driven into it without breaking and firmly holds the nails in place; it is lighter in weight and cheaper to make than any block brought to our attention; although porous and light, it is strong; and, although strong, can be broken on nearly straight lines. With these characteristics its usefulness as a building material, especially in dispensing with the woodwork ordinarily set in the masonry for plastering, and for window-working and door-working, seemed manifest."

With such qualities there developed an unusual demand immediately upon its appearance in the trade. In 1919, the year in which the patentee began seriously to exploit the process, he sold 18,000 blocks. In 1926, he had 77 licensees who sold

Failure of American inventors to supply a need opens the door to foreigners. In two years a business keeping 17 offices busy has grown around this German "Rotaprint" to make offset lithographs in offices

24,533,821 blocks. In the span of those years 77,268,792 blocks were made by licensees, and for each block the patent owner received a royalty of three fourths of a cent.

Naturally, others began to engage in the business without paying a royalty to the owners of the patent. Against Thomas Graham, the Atlantic City Building Block Corporation and others, suits for infringement were brought. Relief was denied them in the Federal District Court but granted in the Circuit Court of Appeals, Judge Wooley declaring:

"Manufacture of the blocks by licensees at widely separated points for local consumption as against mass production at one point for transportation to distant points of consumption is peculiar to the product and is made necessary by the fact that to make a profit the raw material of cinders must be locally available in sufficient quantities and be either free or very cheap. Licenses granted in different trade areas meet this requirement. So at the beginning the licensees obtained their raw cinders from local furnaces for the hauling, but as the demand grew the otherwise free material acquired a money value and now sells at about 15 dollars a carload. In one instance where before the patent it cost the operators of certain furnaces from 7000 dollars to 9000 dollars a year to remove cinders, they now have an annual profit of 15,000 dollars from the sale of cinders for use in the Straub block.

"For 50 years inventors in the cement art have given the subject of cinder aggregates a considerable amount of attention. It does not show, however, that their inventions made any distinctive impression upon the building art. On the contrary it proves that it was not until Straub's invention that the trade turned to blocks with cinder aggregates.

"Hence we must read the Straub invention in the light of the many prior patents and publications. A study of these has convinced us that our decision in the Campbell case, whether by accident or otherwise, was right. It shows that prior inventors and writers had for half a century, indeed from the very beginning of the Portland cement industry, regarded cinders as an aggregate in cement mixtures and had dealt with them in a great number of combinations and proportions and that they had hit upon nearly everything except that which Straub hit upon and had practically surrounded him, yet, we think, without touching him. In some instances they came pretty close, indeed very close, but missed.

"This very activity in a rapidly expanding art indicates to our mind that if all the others failed to see what Straub saw, then Straub saw something new; and the fact that he saw it through a maze of inventions and publications which others failed to penetrate argues for invention. Moreover, the fact that, since our decision sustaining the patent, Straub's conception has founded a great industry while the conceptions of others resulted only in desultory and sporadic activities, indicates the great usefulness of Straub's invention and justifies our previous finding."

Protecting Your Personal Name

CAN a man recover damages if an author or publisher mentions him in a book without his consent? That may depend to some extent upon the particular state in which action is brought, but in New York, at least—and New York is more or less the publishing center of the country—there can be no recovery for the mere use of the name within proper limits and by way of giving local color to the work.

This was made clear when Edna Ferber, novelist, and Doubleday, Doran and Company, publishers of "Show Boat," succeeded in having dismissed a suit for 25,000 dollars damages brought by Wayne Dam-

ron, of Catlettsburg, Kentucky. His name, he declared, was used in the book without his permission "for purposes of trade," which is prohibited by the Civil Rights law. In one chapter of the book "Big Wayne" and "Little Wayne Damron" are referred to as owners of a saloon.

In dismissing the action, Justice Gavegan, of the New York Supreme Court, said:

"It goes without saying that literary expediency may not be advanced as an excuse for violating the statute. It is well established that every incidental mention of some person's name in connection with advertising or trade does not constitute a violation of the provisions under consideration. The single appearance of plaintiff's name in this book is clearly not a use prohibited by the statute. It would impose uncalled for burden and hazard were we to hold that publishers and booksellers could not lawfully publish or deal in books without the production of genuine, written consent, from every one mentioned even once, or that an author could not lawfully mention any one without like consent."

Radios Are Not Machines

IN New York there has been on the statute books since 1922 a law making it a penal offense to remove the manufacturer's serial number from a mechanical instrument. Recently the first arrest was made under it, and the result was merely to narrow the interpretation of the measure.

A representative of the Grigsby-Grunow Manufacturing Company, makers of Majestic radio sets, appeared as complainant against Isaac Greenberg, proprietor of a radio store, charging that Greenberg had several radio sets in his place from which the serial numbers had been removed, thus making it impossible to trace the person to whom the sets originally had been sold. Greenberg refused to give any explanation for the removal of the numbers.

Magistrate Bushel dismissed the case, holding that a radio set is not a mechanical instrument.

Ear Marks of Invention

FOR many years it has been a practice of cattle raisers to identify their stock by means of ear tags. An ear tag consists of a metal strip with a point and sharpened prong at one end and a slot across the other end. The strip is bent into a loop and the prong passed through the ear and through the slot and clinched first inwardly toward the bend of the loop and then backwardly to form a return bend.

From users of such ear tags arose frequent complaints that after the tags were affixed to the cattle's ears, they would catch in brush or wire fencing and would work loose or be torn out. After considerable study, Edwin F. Hennefer patented an ear tag which provided a second hole or slot into which the bent over end of the prong was forced by the pliers in fastening the ear tag to the ear of the animal. After Hennefer's employers, the Jensen-Salsber Laboratories, put this new type of tag on the market, there were no more complaints. It was not long before a rival manufacturer, the Salt Lake Stamp Company, placed a similar tag on the market. Jensen-Salsber sued for infringement.

"The very simplicity of Hennefer's accomplishment creates at first an impression that Hennefer's improvement involved mechanical skill, rather than invention, but simplicity alone is not a reliable test," Judge Sanborn, of the Eighth Circuit Court of Appeals, finds.

Quoting Supreme Court Justice Taft, he says:

" 'Indeed, when one notes the crude working of machines of famous pioneer inventions and discoveries, and compares them with the modern machines and processes exemplifying the principle of the pioneer discovery, one hesitates in the division of credit between the original inventor and the improvers; and certainly finds no reason to withhold from the really meritorious improver, the application of the rule, *'ut res magis valeat quam pereat,'* which has been sustained in so many cases in this court.' "

Resuming his discussion of the ear tag, he concludes,

"Ear tags are old. The desirability of a tag such as Hennefer produced must have been apparent for many years, and yet he was the first to make it.

"The question as to whether this improvement of Hennefer's rose to the dignity of invention is a doubtful one, but the burden was upon the defendant to show that it did not. There was evidence to justify a conclusion that it was a substantial contribution to the art, that it solved a problem which had been under consideration for some time, in an effective and economical way, and that there had been a real demand and need for it. We have reached the conclusion that the trial judge, upon the evidence before him, was justified in holding the patent in suit to be valid."

Patents Seized in the War

FOR ten years the status of the 12,000 enemy-owned patents seized by the United States in the World War has been in doubt. Now at last it is finally settled by the War Claims Arbiter, Judge Edwin B. Parker. He denies to former enemy claimants the right to recover compensation for more than 5000 patents acquired by the United States from the Chemical Foundation, Incorporated, which had purchased them from the Alien Property Custodian at a private sale. The rules and principles Judge Parker announces will govern the preparation, presentation, and decision of claims based on all the patents seized in the War by the Government.

Federal Trade Commission licenses, he holds further, do not come within the terms of the War Claims Settlement Act. He denies the right of numerous claimants for compensation for alleged use by the United States of trademarks owned by the claimants, saying that obviously the United States Government has not pirated any trademark.

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

AIRSHIP—Having a container for gas, a boat-shaped cabin swung from the container, and a plurality of sets of wings projecting laterally on both sides of the container. Patent 1685458. Leonard P. Lidback, 574 Beretania St., Honolulu, Territory of Hawaii.

PROPELLER—Of open construction, in which the active propeller blades are arranged at a distance from the hub, and supported by rods which offer little resistances to the air. Patent 1686214. Royal N. Kyle, Box 36, Gardnerville, Neb.

Chemical Processes

CLEANING COMPOSITION OF MATTER—Which is particularly adapted for cleaning and polishing silver, and consists of diatomaceous earth, calcium chloride, ferric oxide, ammonia, oil of citronella and water. Patent 1685360. Robert B. Hoffman, c/o Monterey Products Co., Monterey, Calif.

Designs

DESIGN FOR A SIGN—Patent 76385. J. F. Fisher, Box 3263, Honolulu, Territory of Hawaii.

DESIGN FOR A COMBINED TOOTHPICK AND DENTAL FLOSS HOLDER—Patent 76490. Ernest T. Lutz, c/o Mrs. M. Finnegan, Beloit, Kans.

DESIGN FOR A DOLL—Patent 76631. Laulie S. Newell and Cora E. Brown, c/o Welsh, Beckham, Farley & Ellis, Olympia Bldg., Miami, Fla.

DESIGN FOR A DOOR—Patent 76494. James A. Pietsch, 101 Cebra Ave., Stapleton, S. I., N. Y.

DESIGN FOR A STOCKING—Patent 76448. Louis D. Barish, 61 W. 9th St., New York, N. Y.

DESIGN FOR A SMOKER'S ASH RECEPTACLE OR SIMILAR ARTICLE—Patent 76625. Angelo J. Mornaghini, 3109 Tilden Ave., Brooklyn, N. Y.

DESIGN FOR AN ESCUTCHEON—Patent 76452. R. E. Bletcher and E. H. Bucknell, 3011 Humboldt St., Los Angeles, Cal.

DESIGN FOR A GLOBE-HOLDING ELECTRIC FIXTURE—Patents 76555 and 76556. Morris Schlepp, c/o Sterling Spinning & Stamping Works, 476 Broome St., New York, N. Y.

DESIGN FOR A DISH OR SIMILAR ARTICLE—Patents 76536 and 76537. William P. Graham, c/o Graham & Zenger Co., 104 5th Ave., New York, N. Y.

DESIGN FOR A COAT—Patent 76522. Katherine E. Burns, c/o Franklin Simon Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A WEATHER VANE—Patent 76316. E. W. Lawson, 509 "O" St., West Palm Beach, Fla.

Electrical Devices

TRANSFORMER—So wound that its magnetic field is confined to a restricted area, so that in close proximity, as in a radio circuit for example, overlapping is prevented. Patent 1687973. Francis De Willy, 2164 Montana St., Los Angeles, Calif.

VOLTAGE-TESTING APPARATUS—To be incorporated with a radio receiver to permit the testing of important elements from time to time,

To the extent that the inventions disclosed by the patents acquired by the Foundation were used either by or for the government of the United States itself, prior to the date of the sale and assignment to the Foundation, the United States must, under the Act of 1928, compensate the former German owners for such use. The Arbiter holds that "this includes all use by or for the United States from August 1, 1914, to April 5, 1917, both dates inclusive, and from November 12, 1918, to (but not including) the date of the sale and assignment of the particular patent by the Custodian to the Foundation."

An Outside Inventor

IF you are seeking a field in which to exercise your talent for invention, you will be more likely to succeed if you select one about which you know something. This is especially true if your invention is an improvement or an attachment, rather than a device of a pioneer nature. A dentist is more likely to produce a practical, profitable invention in the line of dentistry than in the line of radio, just as a radio expert would be more likely to make money out of a radio receiving set than out of a dental plate.

Consider the experience of Percy Osteen, of Anderson, South Carolina. Osteen was a barber in 1916, when he saw a need for an improvement in cameras. The patent he obtained related to folding cameras of the familiar type adapted to take photographs upon a film rolled upon reels mounted within the casing of the camera and fed from the supply reel to the take-up reel step by step as the pictures are taken. Like many another amateur snapshotter, he came to realize that if the film were not advanced after operating the shutter before another picture was taken, two exposures would be made upon the same section of film. He obtained a patent on a method which Judge A. N. Hand, of the Circuit Court of Appeals for the Second Circuit, describes as follows:

"Osteen, the patentee in this case, sought to apply an automatic wind for the film under the control of the shutter to a folding camera. He proposed to use a spring motor for feeding the film as had long before been done in box cameras, and proposed an operating connection between shutter and motor as others had done before.

"But not only was the application of these ideas to box cameras well known, but when attempting to apply them to folding cameras he entered a field already crowded. When Osteen attempted to apply these old elements to a folding camera, he had to make some provision for folding the parts connecting the shutter and motor when the hinged front of the camera was pivoted into a closed position."

Having his patent, Osteen sued Ansco Photoproducts, Inc., for infringement of his patent. He won a decree in the District Court, but this was reversed by the Circuit Court, it being shown that many devices had previously been patented for the same purpose. To avoid this prior art he had to confine himself practically to the structure specifically disclosed in his patent. But if he did that, the Ansco Company was not infringing.

Of the merit of his invention, Judge Hand says:

"It is moreover to be noted that no cameras have ever been manufactured under plaintiff's patent and he seems to have shown no adequate experience in such matters. He testified that when he took out the patent he was in the 'barber business' and at the time of the trial was 'in the theater business.' The device which he made in 1915, he testified, was not made in accordance with the drawings of his patent. It is quite unlikely that a man with such experience could have contributed a meritorious invention to a technical and complicated art, and, at least so far as the claim in suit is concerned, there would seem to be no evidence that he ever did."

Of Interest to Farmers

ADJUSTABLE PLOW AND SHOVEL—Which has novel means for holding the shovel in adjusted position yet permitting the shovel to swing should it strike a stone or the like. Patent 1686961. James T. Davenport, 127 So. Prairie St., Galesburg, Ill.

Of General Interest

RAZOR-STROPPING DEVICE—In which the blade holder operates to prevent the edge of the blade from cutting the strop, or being injured by its engagement with the strop. Patent 1685470. Charles L. Van Amburgh, 333 Dayman St., Long Beach, Calif.

WEATHER SHIELD FOR WINDOWS—Designed for preventing the entrance of drafts, dust, rain or insects, between the sashes and frames adjacent the parting strip. Patent 1687392. Evelyn O. Schaffert, 19302 120 Ave., St. Albans, L. I., N. Y.

MEANS FOR MOULDING RUBBER DRAINING BOARDS FOR SINKS—That they may be so formed of resilient material as to prevent or minimize the unsanitary conditions of moist wood boards. Patent 1688232. James P. Harkin, c/o Collison & Co., 483 Collins St., Melbourne, Australia.

WALL HOOK—For supporting a picture or mirror, a washer in connection with the hook supporting and reinforcing the plaster under and around the nail. Patent 1687413. Carl J. Witt, Caixa 2947, Sao Paulo, Brazil.

SAFETY DEPOSIT VAULT—Which is located under the ground and protected by the ground and the structure itself, secured against the action of the elements and unauthorized removal. Patent 1687431. Charles N. Dilatush, R.R. No. 4, Lebanon, Ohio.

STENOGAUGE—For use by stenographers and typists to ascertain the position of the carriage of a typewriter at the beginning of writing a caption and centering the same. Patent 1687429. Roy G. Datson, c/o Pyramid Packing Co., 375 Coleman Bldg., Seattle, Wash.

FILING STRUCTURE—For use in filing data pertaining to real estate or similar transactions, wherein the cards are partially locked in place for vertical filing and unobstructed observation. Patent 1685448. Thomas C. Butterworth, Box 866, Mill Valley, Calif.

HOME SAVINGS BANK—Of the small type issued by banking institutions, proof against being opened except through special means in the custody of the institution only. Patent 1686201. Carl W. Cherry, Box 863, Carmel, Calif.

COMBINATION DOOR STOP AND HOLDER—Which is rigidly attached to the floor, and includes a buffer for stopping the door, and a catch for holding the door in open position. Patent 1688221. Charles J. Abbey, 116 Madison Ave., Skowhegan, Me.

SPRING-PRESSURE BUTTON—Which assures a reliable fastening for fabrics, while its two component parts may be readily separated without strain upon the attaching means. Patent 1688272. Louis Fouletier, c/o C. Bletry, 2 Boulevard de Strasbourg, Paris, France.

MAGNETIC - LOCK - OPERATING DEVICE—For unlocking and locking spring actuated doors of small home savings banks, the special magnetic key being in the custody of the institution issuing the bank. Patent 1686202. Carl W. Cherry, Box 863, Carmel, Calif.

ELECTRICAL COMPOUND LETTER—For electrical signs, wherein all letters of the alphabet, numbers and other configurations may be produced by causing different groups of lights to be lighted. Patent 1688266. Bradford D. Coffey, 693 Bergen Ave., Jersey City, N. J.

Unauthorized Selling Is Not Trademark Infringement

TRADEMARK registration has its limitations. You cannot, for example, construe the use of your mark by an unauthorized dealer as an act of infringement, provided the goods he sells are the genuine article.

This was made clear recently when the Gotham Silk Hosiery Company, Inc., tried in vain to enjoin Arthur and Joseph Goldstein, small retailers, from selling the well known "Gotham Gold Stripe" hosiery. The Goldsteins had had no dealings with the Gotham Company, but had bought Gotham stockings from other dealers and advertised them for sale at prices below those of authorized Gotham dealers.

The Gotham Company does not sell to retailers generally or to jobbers, but through its own retail stores and dealers of its own selection. To retail purchasers it grants the privilege of returning its stockings for repair at nominal cost, for redyeing, for exchange or for cash or credit if defective. It attributes its success in part to these methods and upon them it bases a retail price which it "suggests" to dealers. When the Goldsteins began advertising and selling Gotham hosiery, the Gotham Company sought an injunction, maintaining that they were holding themselves out as authorized Gotham dealers.

Judge Thacker, of the Federal District Court for Southern New York, finds, however:

"The natural inference to be drawn from the fact that the product is offered at cut rates and from the defendant's evident purpose to create the impression that he was underselling the regular Gotham dealers, is that he did not hold himself out as a regular dealer, and I accept his denial of any such representation as more credible than the testimony of interested witnesses to the contrary. So far as the use of the trademarks is concerned, they were used only in connection with the advertising and sale of genuine "Gotham Gold Stripe" Stockings and there was consequently no infringement.

"Their use on paper bags in which all kinds of merchandise was wrapped for customers was merely advertising, and not intended to falsely mark the goods contained in the bag. This is clear from the evidence that the stockings were not sold in the bags and that purchasers were told what they were buying before their purchases were put in the bags. Nor was the use of genuine Gotham labels on boxes in which the defendant kept genuine Gotham stockings on his shelves infringement of the trademarks. In all this there was neither attempt to deceive or to palm off spurious goods, nor was there any confusion of goods whatsoever."

BOOKSTAND—Which will conveniently support any desired number of books, such as telephone books, or binders carrying the books, and enable each book to be swung into position for use, and when not in use swung back into the casing. The inventor has been granted two patents 1687443 and 1687444. Walter E. Haskin, c/o Pressed and Welded Steel Products Co., 326 Boulevard, Long Island City, N. Y.

DISPLAY DEVICE FOR SCREENS—Which will support screen doors or other screens so that they may be easily displayed and a relatively large number located in a small space. Patent 1688255. Louis Wasch, 1139 E. Mahanoy City, Pa.

HOLDER FOR LEDGER SHEETS—For retaining a plurality of sheets, for example, a ledger sheet and a depositor's statement, during the various manipulations of posting or filing bank balances. Patent 1688264. John C. Carpenter, c/o The Oswego Democrat, Oswego, Kansas.

Hardware and Tools

ROTARY REAMER—Formed with reversible cutting edges, both of which may be used before the shoe is renewed or re-sharpened, and may be readily replaced when dulled. Patent 168403. Alexander Boynton, 1800 San Pedro Ave, San Antonio, Texas.

DRIVER CHUCK—A tool adapted for screwing the nut of a flexible stay bolt onto the bolt in the socket, or removing the nut from the bolt and socket. Patent 1686412. Harry A. Lacerda, 1427 5th Ave., Watervliet, N. Y.

LOCK—Of the spring pressed bolt, or "night latch" type, which is practically immune from outside forcing, but may be freely operated with the proper key. Patent 1687388. Jorge Rigo, Reyes 89, Vibora, Habana, Cuba.

Heating and Lighting

COMBINATION GAS AND OIL BURNER—Including a circular series of gas nozzles, an oil burner located centrally, and an air casing around the gas nozzles with means for controlling the air. Patent 1687390. Eugene Ritter, Box 981, Monroe, La.

LIQUID-FUEL BURNER—Wherein air under pressure is eliminated, but which utilizes atmospheric pressure which is admitted to the burner in proportion to the liquid fuel supply thus reducing fuel consumption. Patent 1687386. John H. Reeve, 434 Larrabee St., Portland, Ore.

Musical Devices

MUSICAL INSTRUMENT—A construction for head instruments, wherein is presented a rim and bottom for supporting a diaphragm so that the sound produced may pass from both sides. Patent 1685706. F. Gretsch, 60 Broadway, Brooklyn, N. Y.

APPARATUS FOR TEACHING SIGHT SINGING—Which may be conveniently manipulated by a teacher to display musical notes on a staff board, where large groups of students are to be handled at one time. Patent 1685682. M. B. Rock, 314 Rockland Ave., West Brighton, S. I., N. Y.

MUSICAL-INSTRUMENT STAND—Which can readily be collapsed, and is particularly adapted for holding banjos and like instruments when not in use, to prevent accidental knocking over. Patent 1684912. C. T. Dunklau, 138 E. 104 St., Los Angeles, Cal.

Machines and Mechanical Devices

SCREEN CLEANER—For cleaning screens through which a spraying mixture of paint, or like substance is forced, the particles in suspension being removed by an oscilliating brush. Patent 1687428. Levin O. Corkran, Chesterfield Farm, Rhodesdale, Md.

BURGLAR ALARM—So arranged that a burglar or, unauthorized person, cannot enter an open window or door, or force a closed one, without sounding a signal. Patent 1686457. Thaddeus S. McClintock,923 Timberlands Ave., Pittsburgh, Pa.

MACHINE FOR CASTING STEREOTYPE PLATES—In which the frame is supported by the furnace walls by eccentric bushes, and is standardized for all sizes of newspapers. Patent 1686429. Carl Winkler, Bern, Switzerland.

SHOE RACK—A simple and compact device with movable rollers for supporting and conveying a plurality of shoes in any formative stage through a factory. Patent 1687397. Charles E. Shively, 1125 8th St., Portsmouth, Ohio.

METHOD OF AND APPARATUS FOR CEMENTING OIL, GAS, AND WATER WELLS—Which makes it possible to introduce cement down through the well casing between plugs, and hold the plugs in position until the cement sets. Patent 1687424. Alexander Boynton, 1800 San Pedro Ave., San Antonio, Texas.

PROCESS OF FORMING PIPE CLOSURES—In which a plug having a circumferential groove and flange, is inserted into a red hot pipe end and the pipe bent into the groove and welded. Patent 1686562. Percy Jackson, P.O. Box 1551, Cincinnati, Ohio.

FILM MAGAZINE—Particularly designed to accommodate "spool films" as used in motion picture photography, mechanism being provided for sealing the magazine against the entry of light to the film. Patent 1686204. Byron V. Covert, Lockport, N. Y.

FLUSH-VALVE MECHANISM—In which the liquid-tight scaling of the outlet port is positively effected with each closing of the valve, thus eliminating water waste. Patent 1686932. Morris Schiller, 830 Milwood Ave., Venice, Calif.

TESTING OR DEMONSTRATING APPARATUS—For testing the rolling qualities of spherical objects, such as golf balls, or other objects which are depended upon for interbalance and rolling accuracy. Patent 1688274. Bryce Haynes, 1 Sheridan Sq., New York, N. Y.

ADVERTISING DEVICE FOR DISPENSING MACHINES—The advertising matter being operable to attract attention in response to the operation of a manipulator forming a part of the machine. Patent 1688278. John E. Kenkel, Great Falls, Montana.

LIQUID-SUPPLY TANK—Having a float valve for controlling the supply of liquid from one reservoir to another, so that a predetermined volume will be at all times contained in both. Patent 1688279. William S. Locke, c/o Portland Realty & Trust Co., 214 Railway Exchange Bldg., Portland, Ore.

MACHINE FOR ROUNDING GEAR WHEELS—A hand operated instrument which will accurately true up a gear wheel so that all the openings between the teeth will be of the same depth. Patent 1688243. Jesus L. Limeres, c/o Augustus Pacette, Calle Pasco 27, Habana, Cuba.

MULTIPLICATION DEVICE — Comprising a plurality of movable elements, by which any number can be multiplied by any one of the digits and the correct product obtained. Patent 1687182. Kurt Seifert, P.O. Box 621, Los Angeles, Calif.

Prime Movers and Their Accessories

FUEL-MIXING AND SUPERCHARGING DEVICE—For controlling and regulating the flow of air and liquid fuel, mixing the two together, atomizing the resulting mixture, and forcing the same into an intake. Patent 1686413. Philip J. Laronde, R.F.D. 9, No. River Road, Manchester, N. H.

INTERNAL - COMBUSTION MOTOR—So constructed that the connection between the crank shaft and piston rod compensates for wear and insures a silent and effective operating engagement at all times. Patent 1687425. Henry Briggs, 244 Walter Ave., Hasbrouck Heights, N. J.

Railways and Their Accessories

RAIL JOINT—In the form of a splice or fish plate, which affords facilities for connecting the meeting ends of rails so that they will be held against displacement. Patent 1685704. A. L. Collins, Sr., Box 363, Amite, La.

REFLECTOR—Designed to reflect a portion of the main light beam of the locomotive headlight for illuminating the foot board or steps of the locomotive. Patent 1686476. Damon E. Stinson, 309 Holladay Ave., Portland, Ore.

Pertaining to Recreation

GAME APPARATUS—Having a wide range of utility for educational and amusement purposes, both facilitating the teaching of spelling to children, and an amusement to persons of all ages. Patent 1685723. M. J. Robins, Florena Nightingale School, Katonah, N. Y.

WHEELED TOY VEHICLE—of the so-called "scooter" type of wheel coaster, having a platform with a box body forwardly thereof, leaving a standing platform in the rear. Patent 1686427. Paul T. Wallgren, 5237 No. Sawyer Ave., Chicago, Ill.

Pertaining to Vehicles

BRAKE—Which facilitates the making use of a suitable liquid or air, to expand a braking member to frictionally contact with an associated brake drum. Patent 1685709. A. E. Lee, 255 Shawnee Path, Akron, Ohio.

LUGGAGE CARRIER—Attachable to an automobile, and is adapted to have a relatively great carrying capacity when extended, and to take up but little space when folded. Patent 1686450. William Henry, 1225 Greenwood Ave., Rockford, Ill.

TESTING DEVICE FOR VALVES—A tire valve tester which embodies the use of liquid into which air escaping is caused to form bubbles thus visibly indicating a leak. Patent 1685454. Carl Johnson, 727 W. 53 St., Los Angeles, Calif.

DIRIGIBLE HEADLIGHT—Which imparts in a smooth and easy manner the movement of the headlights when the automobile is steered, and takes up within itself vibration. Patent 1686459. Fred McKenney, c/o John S. Winkle, Volunteer Life Bldg., Chattanoogo, Tenn.

AUTOSLEIGH—With means for facilitating travel of the vehicle over snow and ice covered surfaces, certain of the runners being attachable to the vehicle and others to the wheels. Patent 1687455. Francis A. Klein, 920 2nd St., Xenia, Ohio.

DIRECTION-INDICATING SIGNAL—Consisting of a casing containing a tubular expansible and contractible member, projected and withdrawn by air pressure, the driver readily controlling the air flow. Patent 1685330. John M. Maroney, 601 Hobart St., Oakland, Calif.

ADJUSTABLE VEHICLE SEAT—Which may be quickly adjusted horizontally toward or away from the steering wheel, or vertically, and the seat or back tilted, to suit a driver's requirements. Patent 1685770. Richard E. Bowen, 1748 Rimpan Blvd., Los Angeles, Calif.

DIRIGIBLE SPOTLIGHT—Associated with the steering mechanism, to direct the light rays so that the edge of the road will at all times be visible to the driver. Patent 1687173. Boyd F. Miller, Box 80, Eldridge, Calif.

AQUATIC VEHICLE—For supporting a person in either a seated or swimming position, the lower body being submerged, the vehicle embodying means whereby the person may propel it. Patent 1687194. James F. Caldwell, Box 121, Watts, Calif.

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